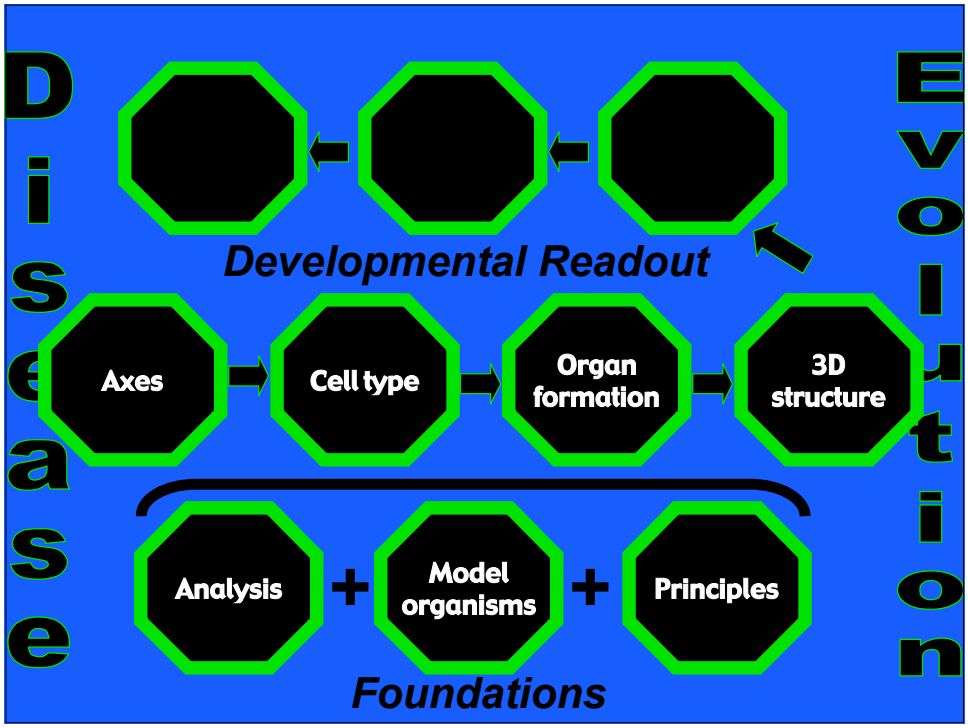
7.72
11.1.06

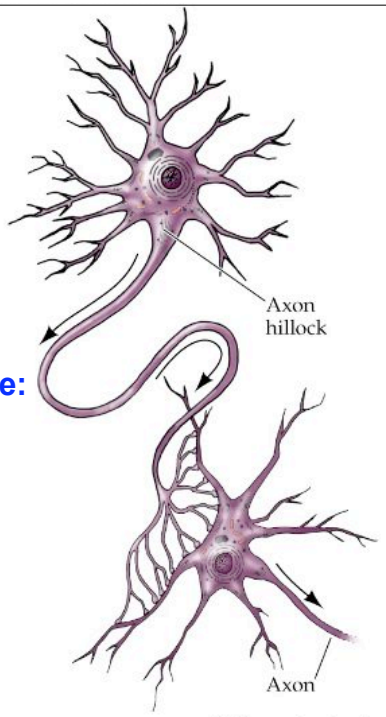
Morphogenesis



What is morphogenesis?

1

Specialized cell shape: neuron

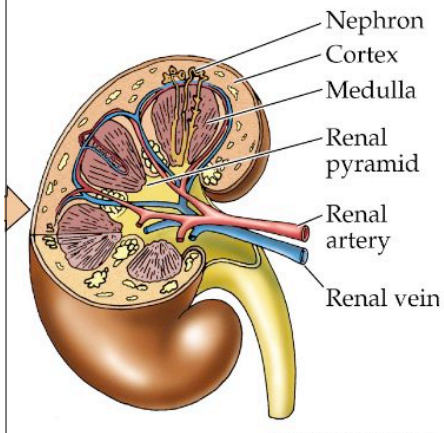


2

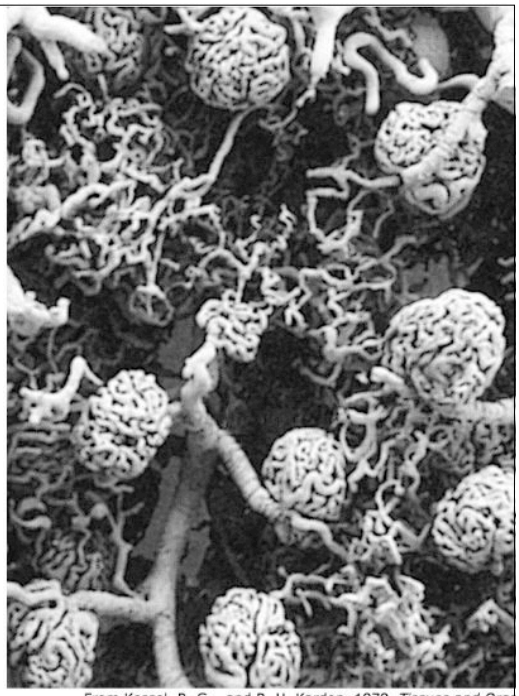
Wound healing

Dr. D. Becker, UCL

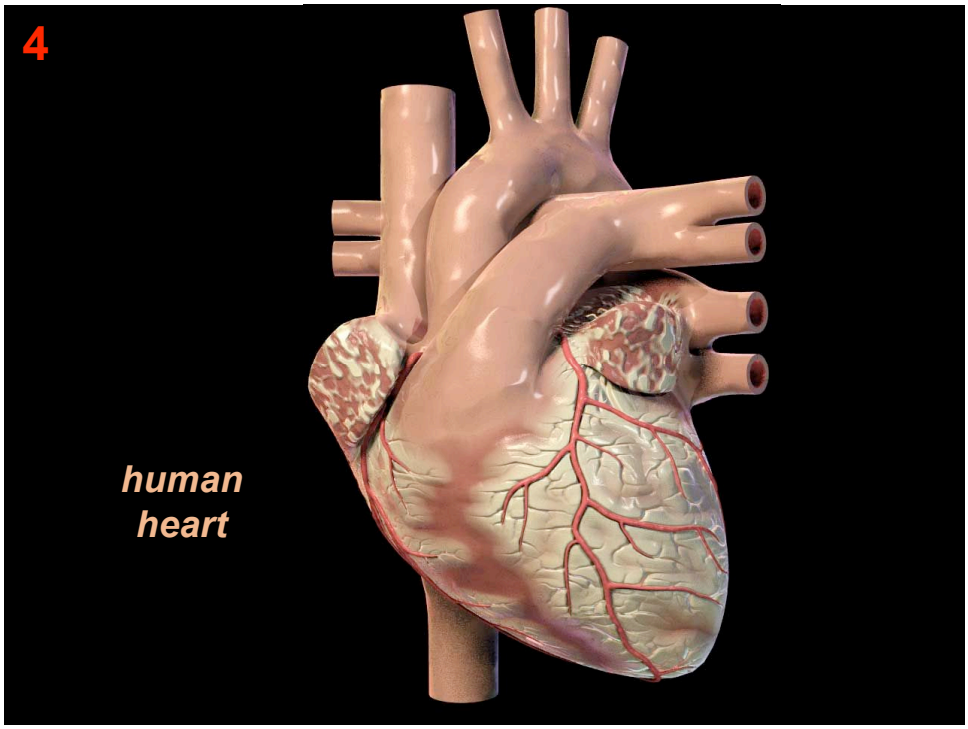
3



Kidney



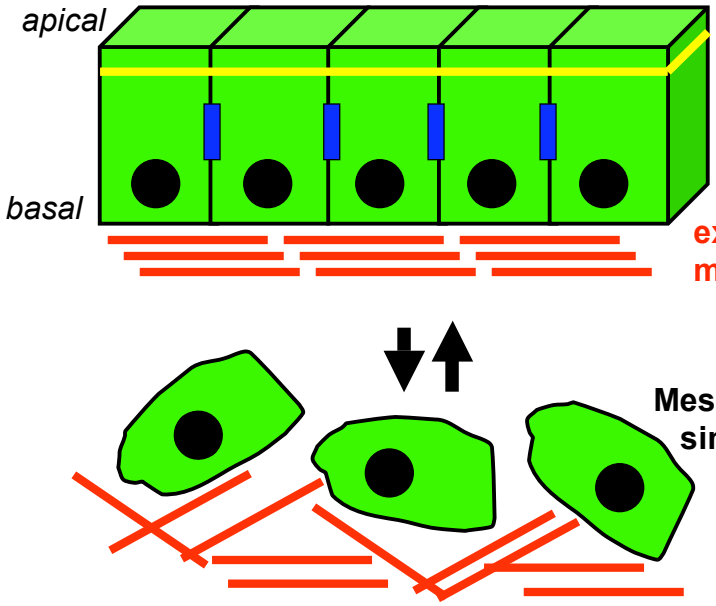
From Kessel, R. G., and R. H. Kardon, 1979. *Tissues and Orga*
W. H. Freeman, San Franc



Universal processes

5

Epithelial/mesenchymal transition (EMT)



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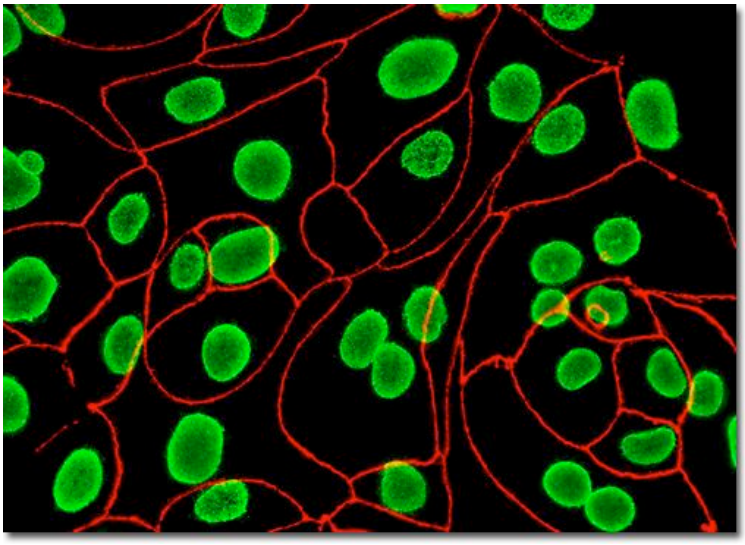
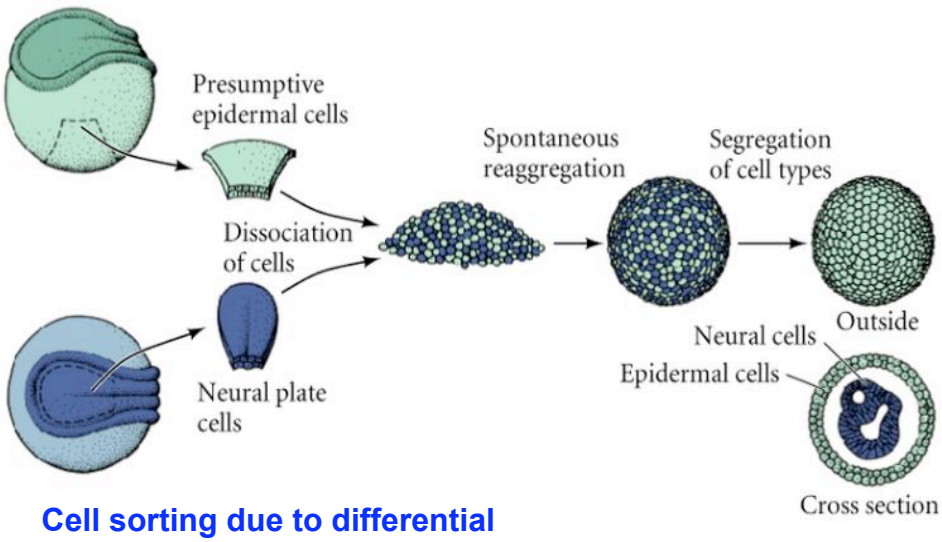
6



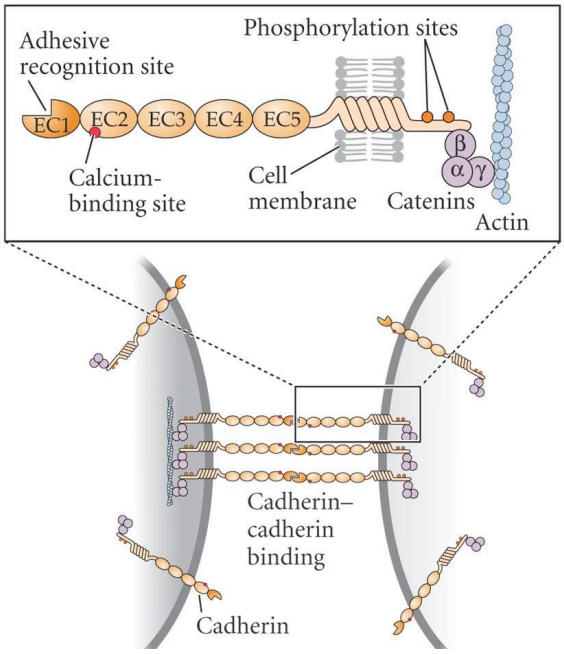
Epithelial sheet stained for occludin
a tight junction-specific protein (red)

7



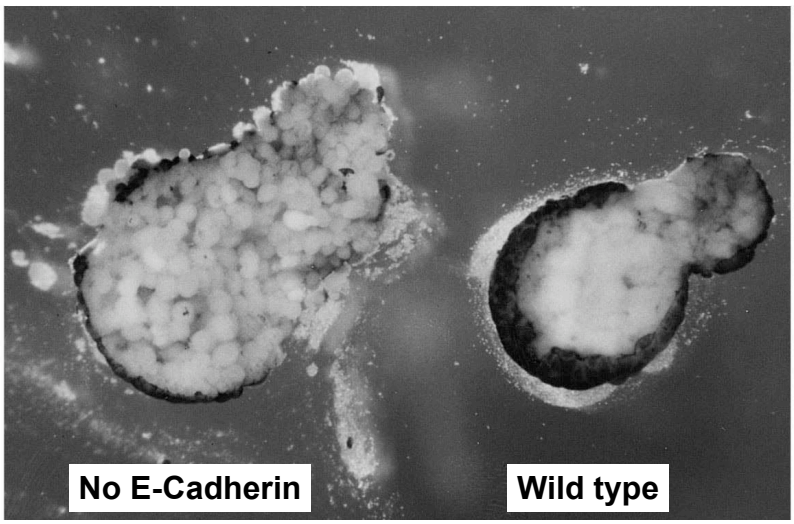
Cell sorting due to differential and homotypic cell adhesion (N-Cadherin vs E-cadherin)

8



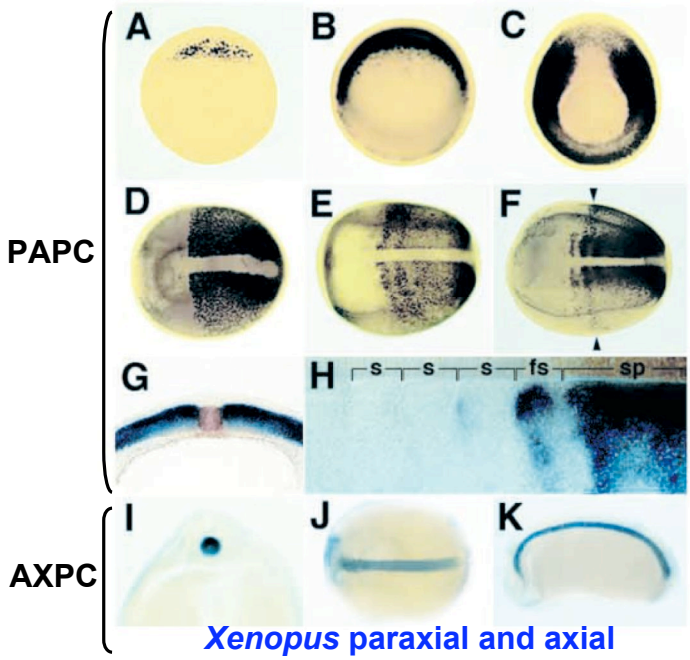
Cadherin-mediated cell adhesion

9



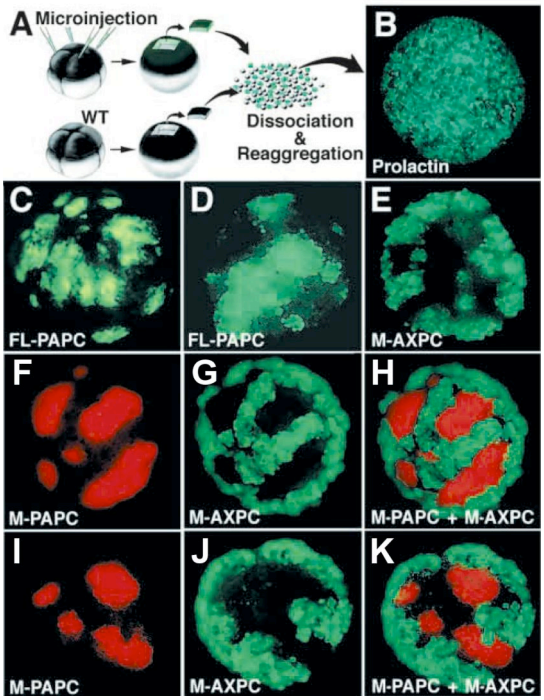
Cadherins are required for cohesion between developing cells/ frog embryos

10



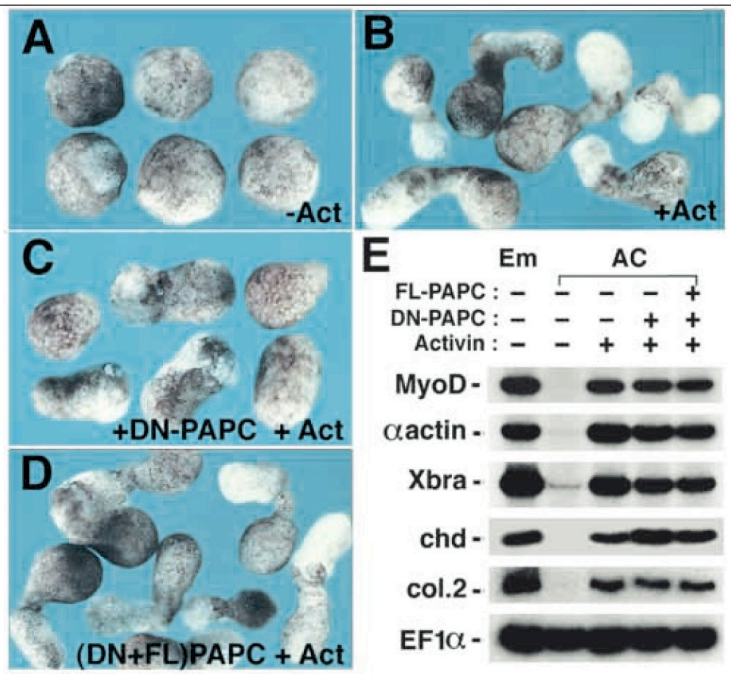
Xenopus paraxial and axial protocadherin (PAPC, AXPC) expression

11



PAPC, AXPC mediate cell sorting

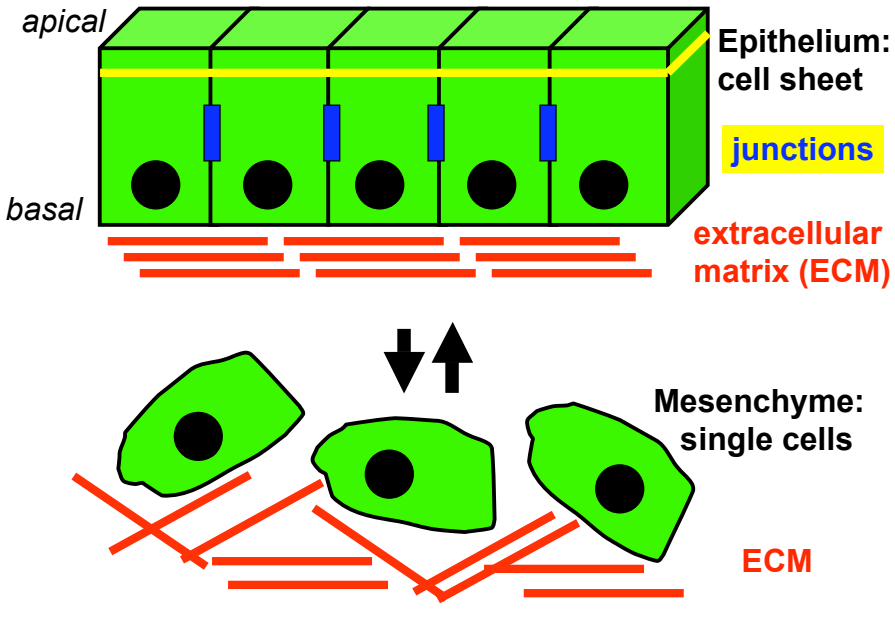
12



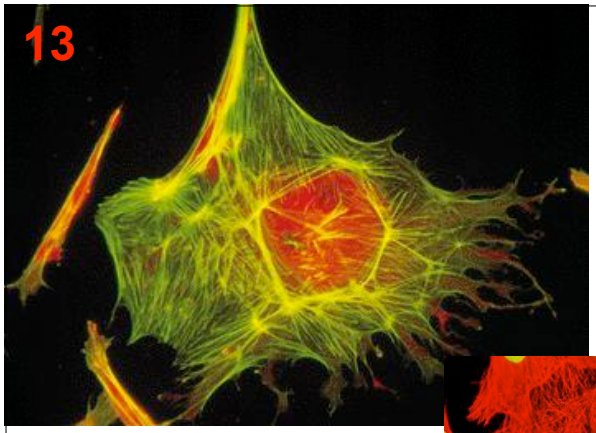
DN-PAPC does not alter cell type determination

Mesenchymal and epithelial behaviors

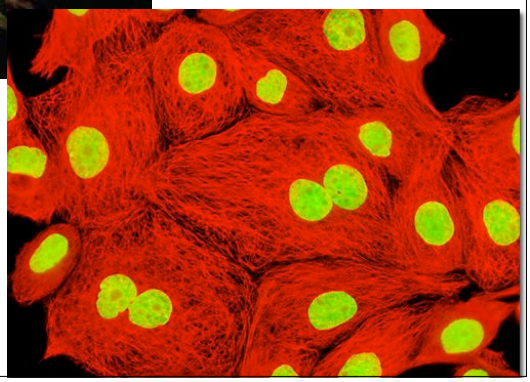
Epithelial/mesenchymal transition (EMT)



13

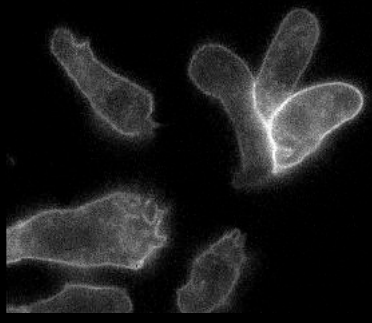


Microfilament network stained for actin (yellow)



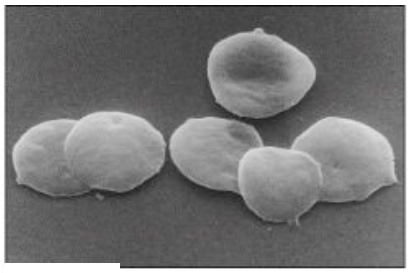
Microtubule network stained for tubulin (red)

14

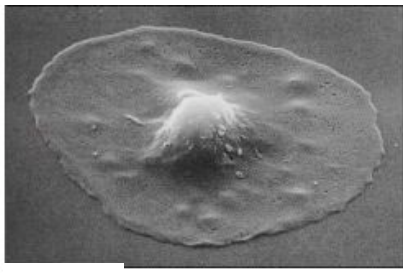


Chemotaxis toward cAMP source (→)
(Dictyostelium)

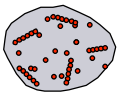
15 Platelets changing shape during clotting



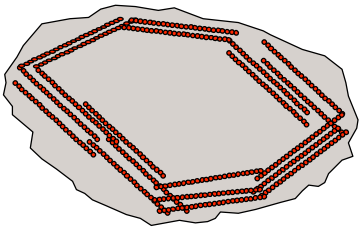
resting



clotting



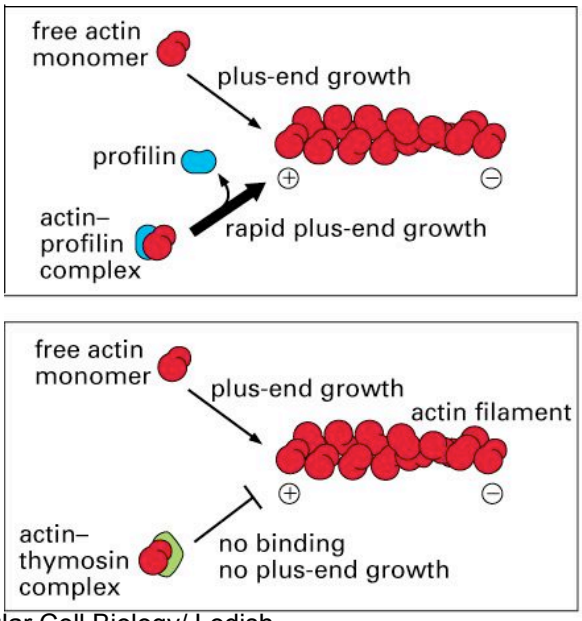
G-actin unpolymerized



F-actin polymerized

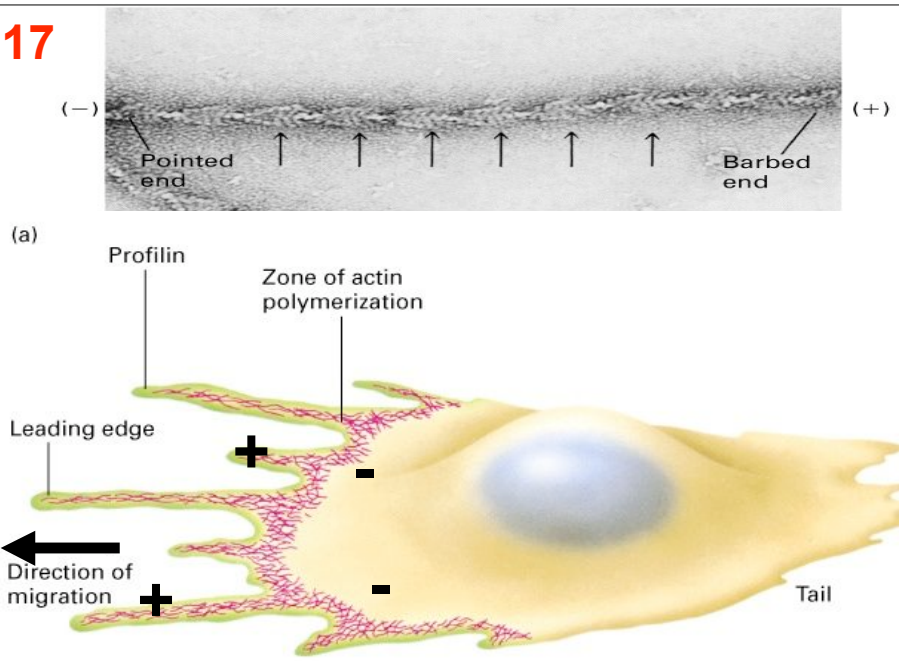
From Molecular Cell Biology/ Lodish

16 Regulation of actin polymerization



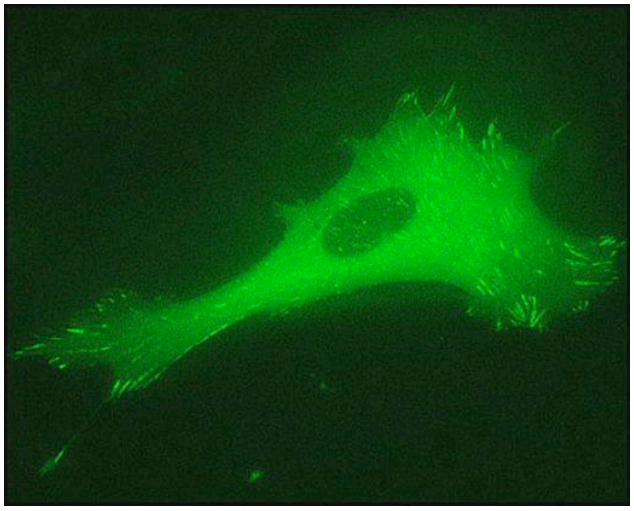
From Molecular Cell Biology/ Lodish

17



From Molecular Cell Biology/ Lodish

18

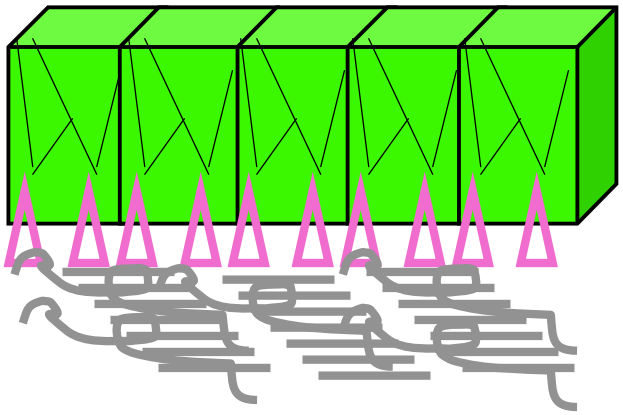


Rearrangement of microfilaments (F-actin) with cell movement

19

See Purves 4.26

Extracellular matrix is cell substrate: receptors connect ECM and cells



Cells

cytoskeleton

Receptors

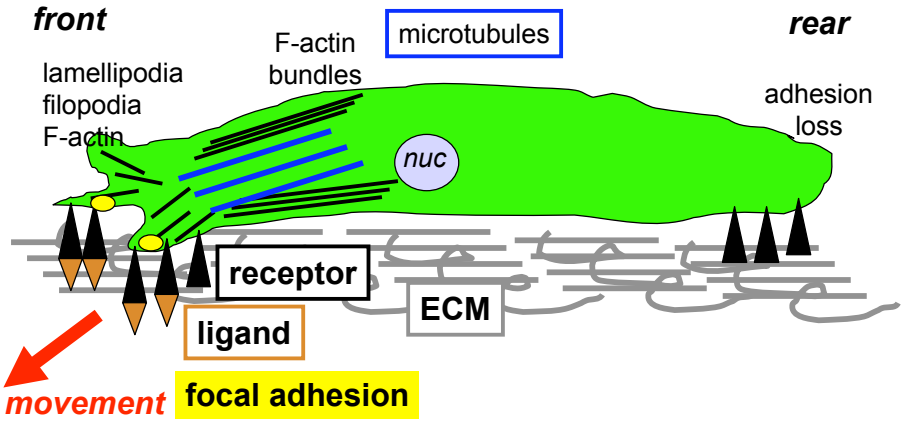
ECM
(basement membrane)
proteins
proteoglycans

Receptors: adhesion receptors, ex. integrins
ECM proteins: ex. collagen

H. Sive MIT 2006

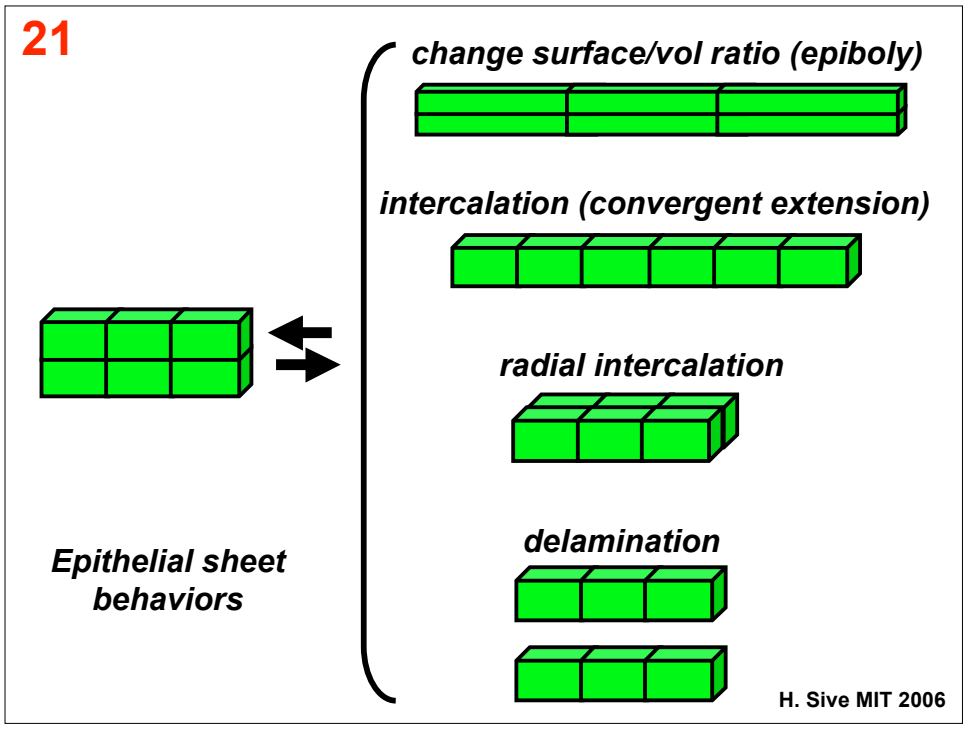
20

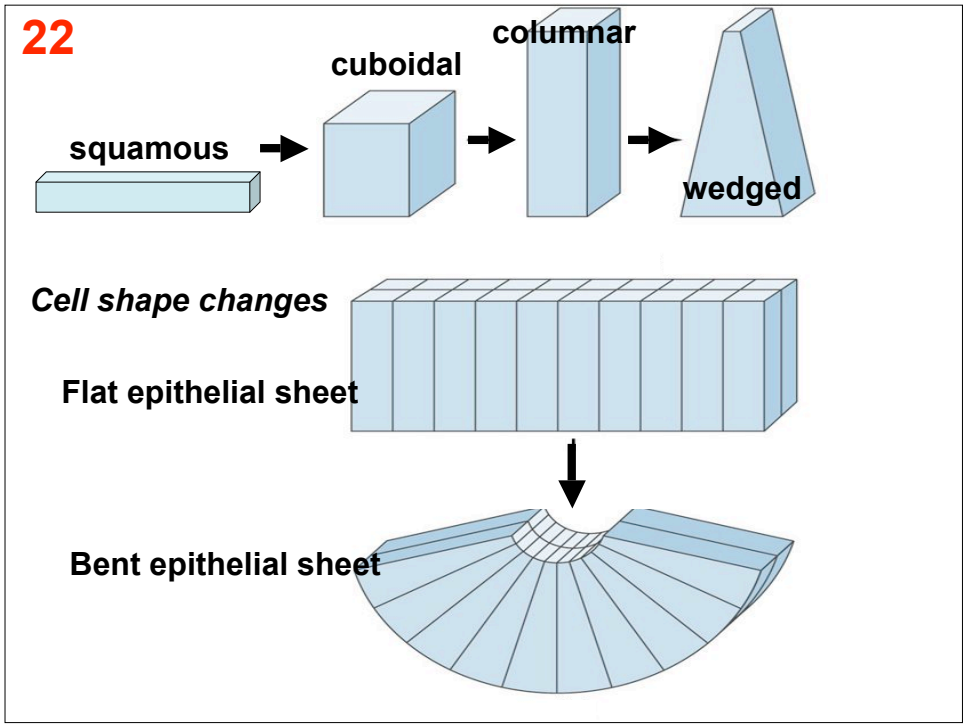
Cell movement and signaling



Signal > integrin > FAK> rac/cdc42/rho > profilin > f-actin
ligand receptor kinase GTPases

H. Sive MIT 2006


21
change surface/vol ratio (epiboly)
intercalation (convergent extension)
radial intercalation
delamination
Epithelial sheet behaviors
H. Sive MIT 2006

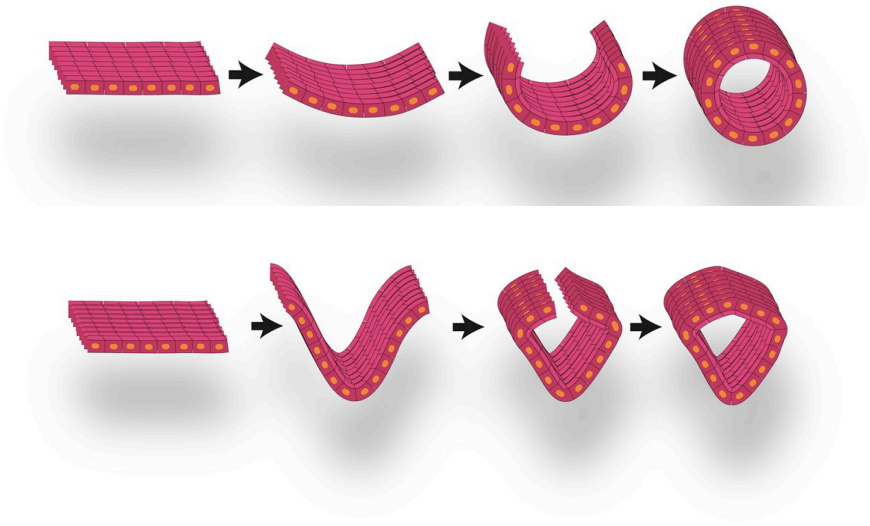

22
squamous
cuboidal
columnar
wedged
Cell shape changes
Flat epithelial sheet
Bent epithelial sheet

Tubes

23

Epithelial sheets can roll or bend to form a tube

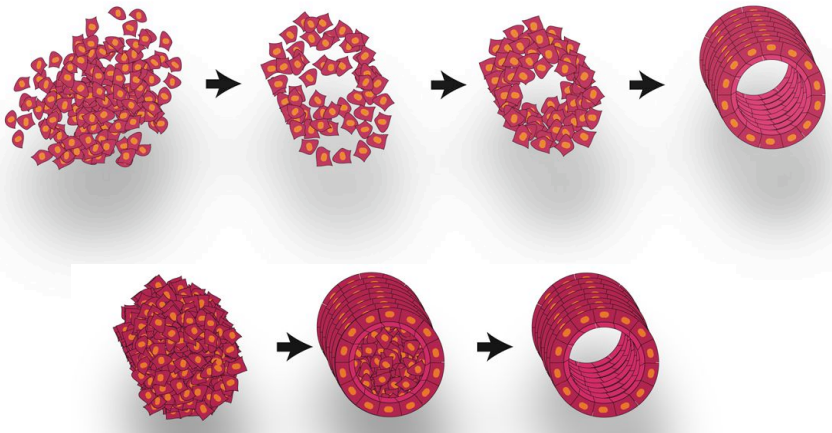
Examples: brain, spinal cord



24

Mesenchymal cells can condense to form a tube

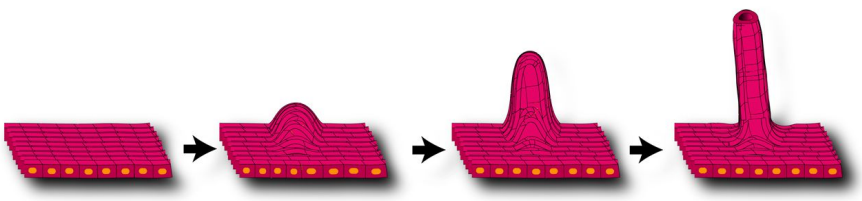
Examples: tail spinal cord, blood vessels, kidney tubules



25

An epithelial sheet can extend to form a tube

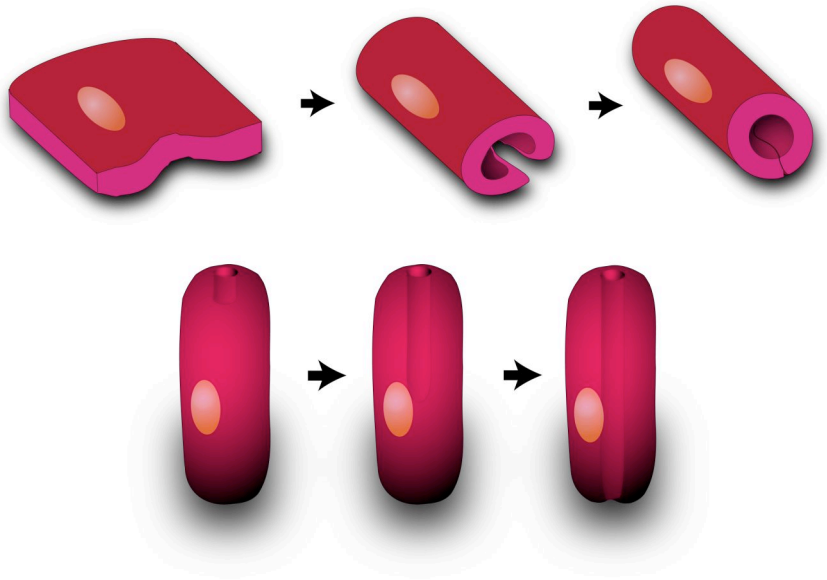
Example: primary lung tubules



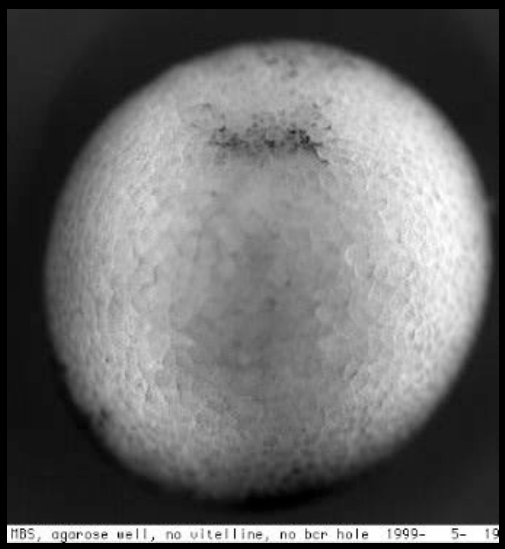
26

Single cells can roll or hollow into tubes

Examples: secondary and terminal tracheal tubules



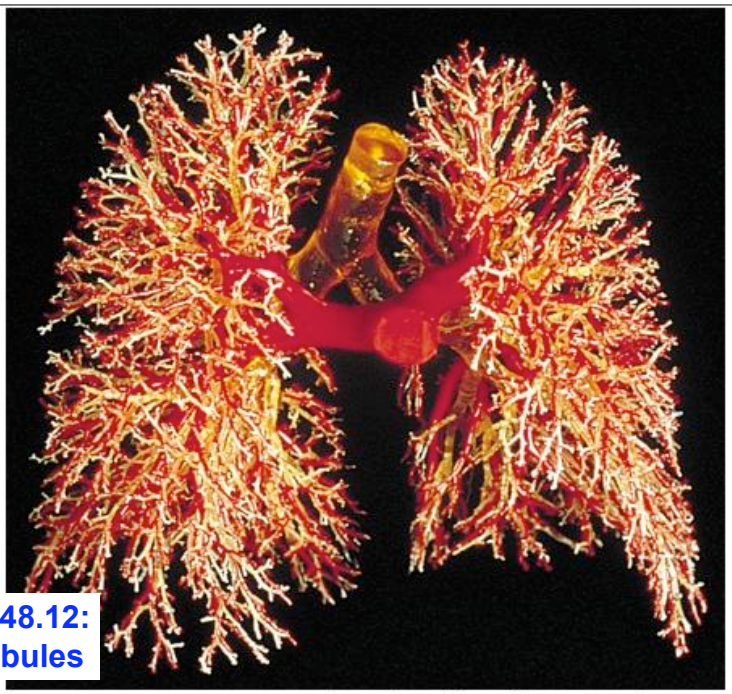
27



Amphibian neural tube forms by rolling up an epithelial sheet

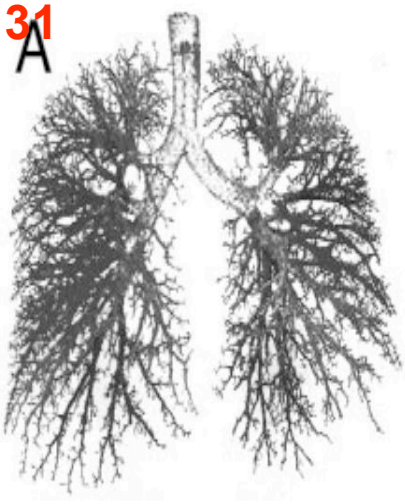
Ray Keller

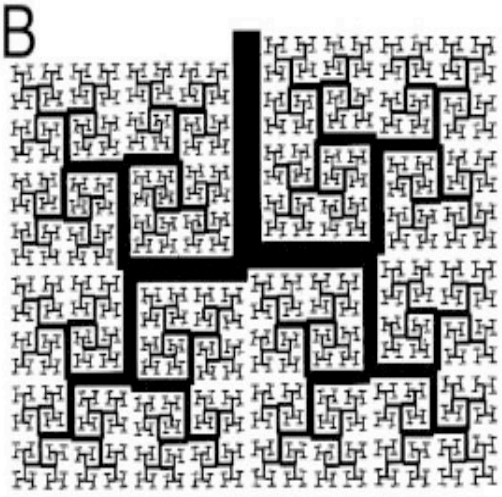
30



Purves 48.12:
Lung tubules

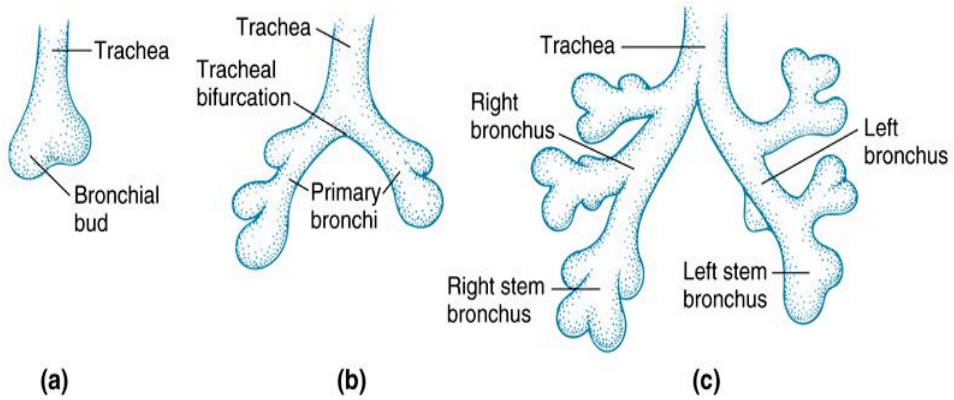
31





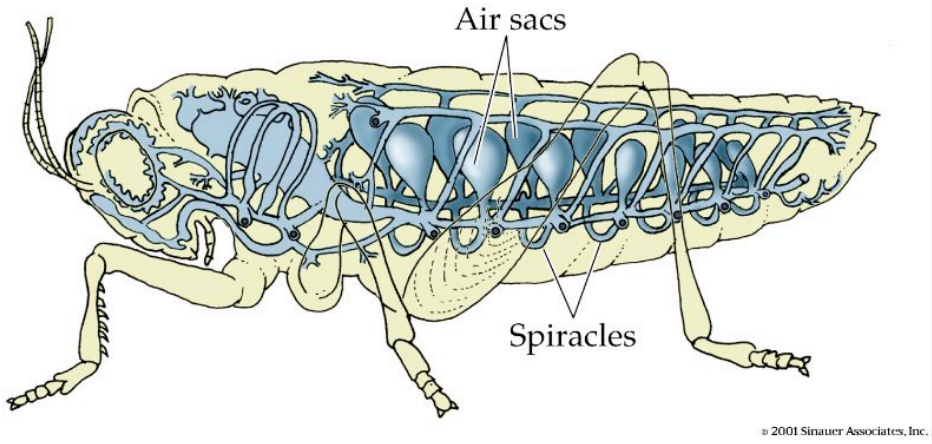
Lung branching (A)
versus pattern derived from reiterative function (fractal)(B)

32



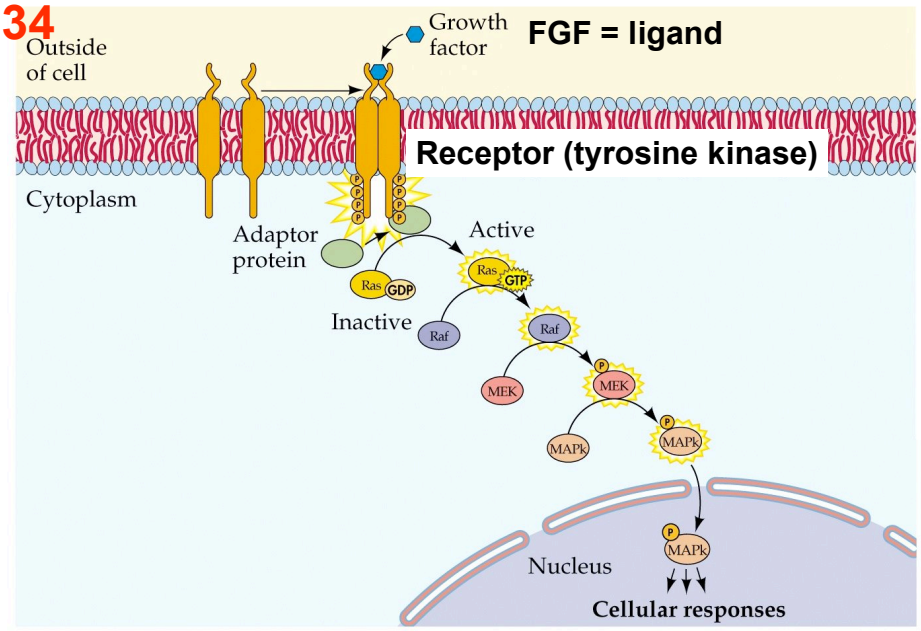
Lung tubule morphogenesis: initial steps

33



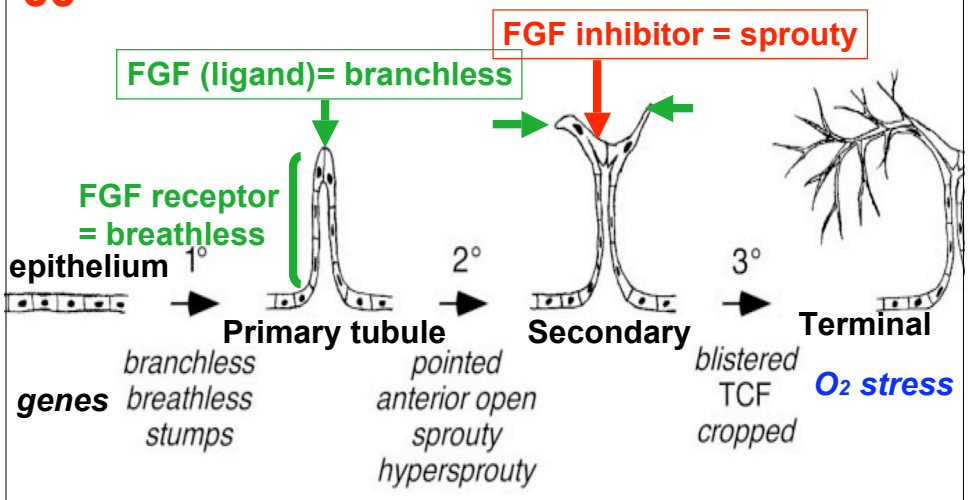
insect tracheal system = lung

34



Fibroblast Growth Factor signaling

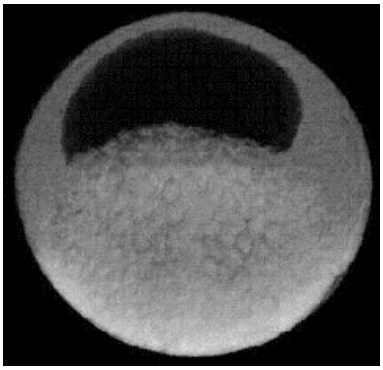
35



Primary tracheal outgrowth and branching (Drosophila)

Gastrulation

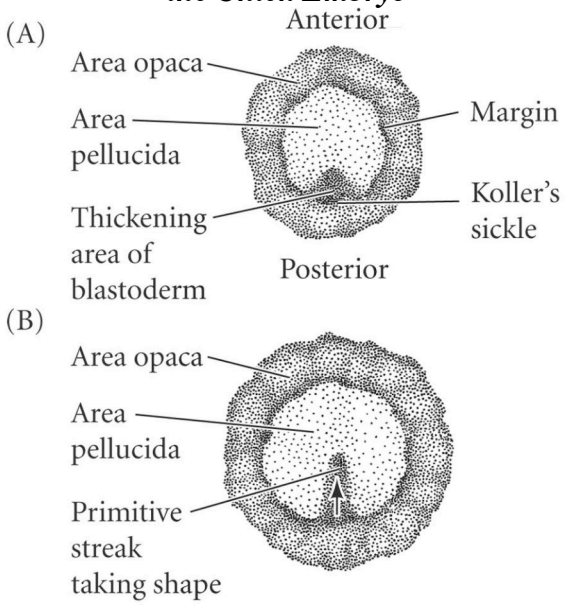
36



Gastrulation = cell movement, determination
~10,000 cells (frog)

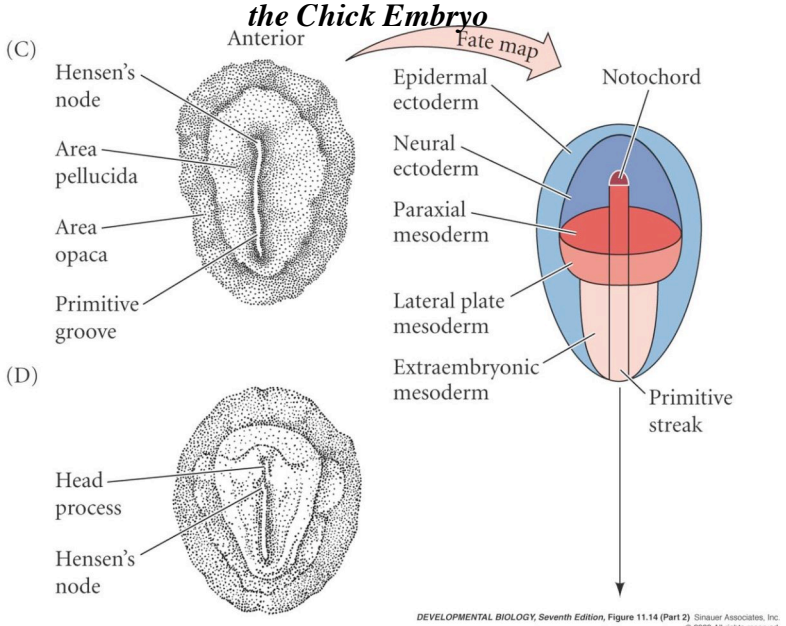
Mike Danilchik

37 **Gilbert 11.14(1)** ***Cell Movements of the Primitive Streak of the Chick Embryo***



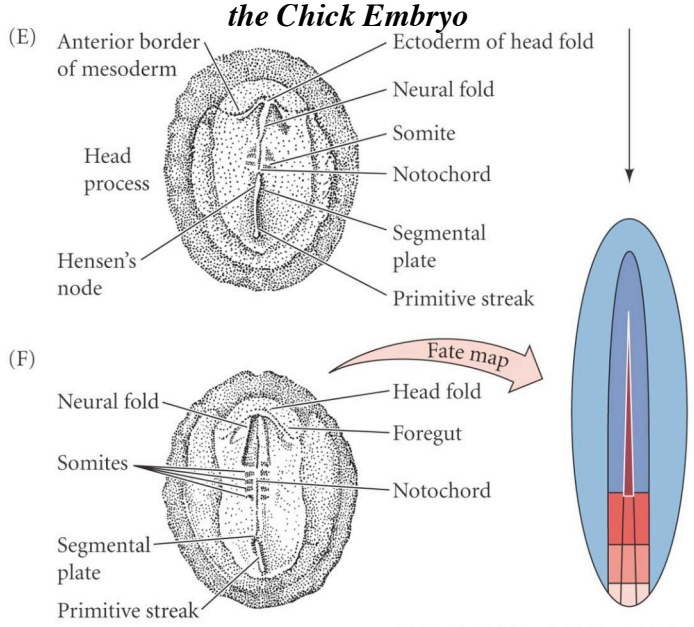
DEVELOPMENTAL BIOLOGY, Seventh Edition, Figure 11.14 (Part 1) Sinauer Associates, Inc.

38 **Gilbert 11.14(2)** ***Cell Movements of the Primitive Streak of the Chick Embryo***



DEVELOPMENTAL BIOLOGY, Seventh Edition, Figure 11.14 (Part 2) Sinauer Associates, Inc.

39 **Gilbert 11.14(3)** ***Cell Movements of the Primitive Streak of the Chick Embryo***



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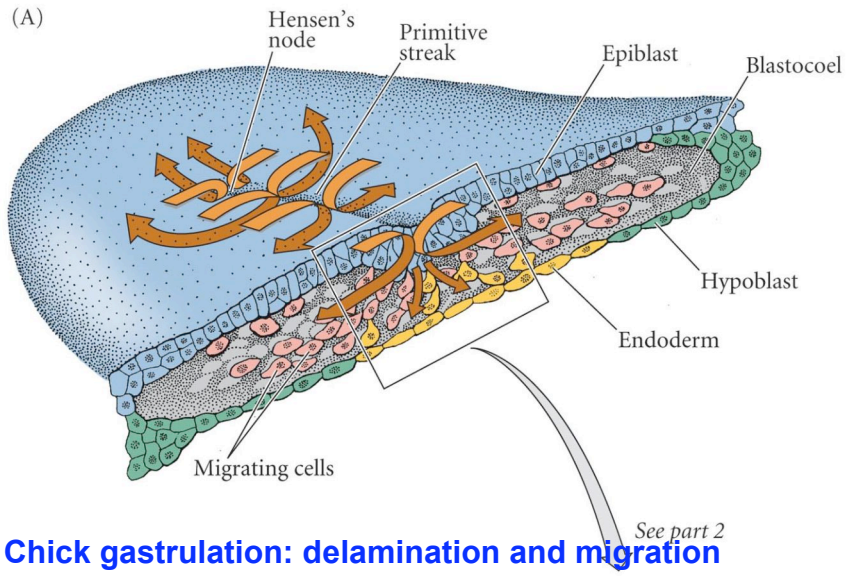
40



Chick gastrulation: delamination and migration

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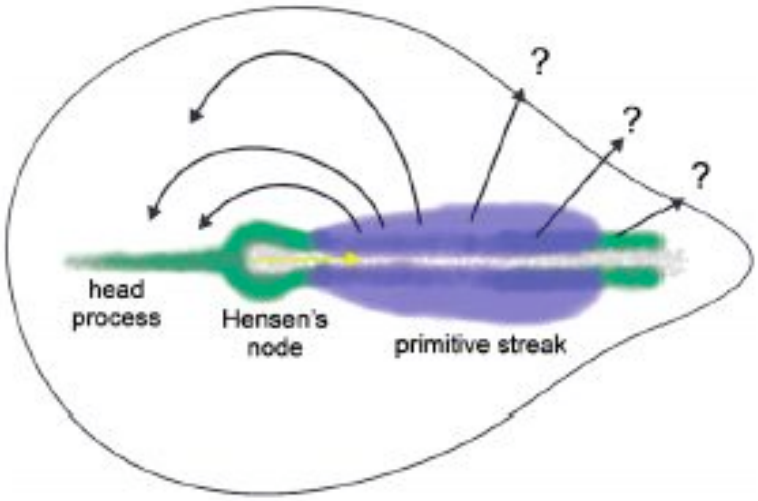
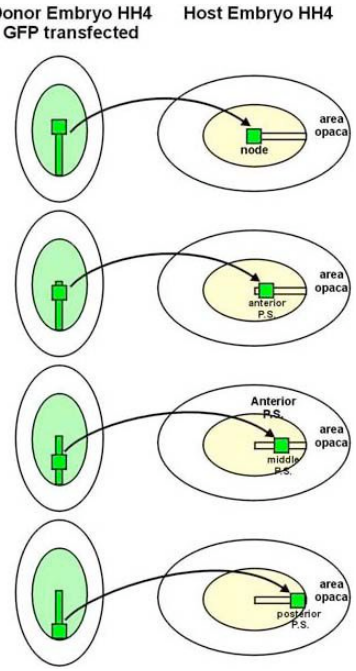
41



Mid-streak cells move away from midline and then turn back

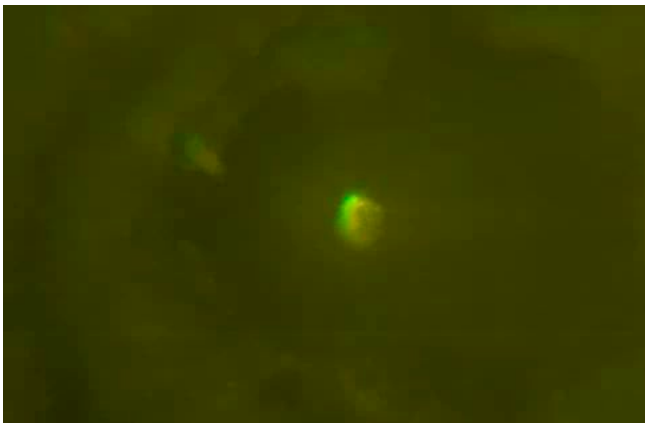
Yang et al (2002) Dev Cell ***3***:25-37

42

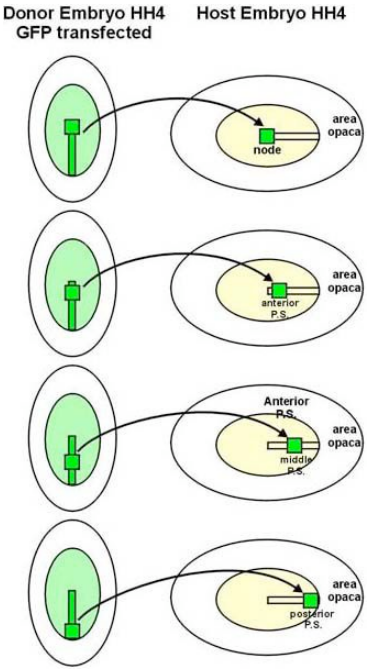


Transplants during chick gastrulation

43

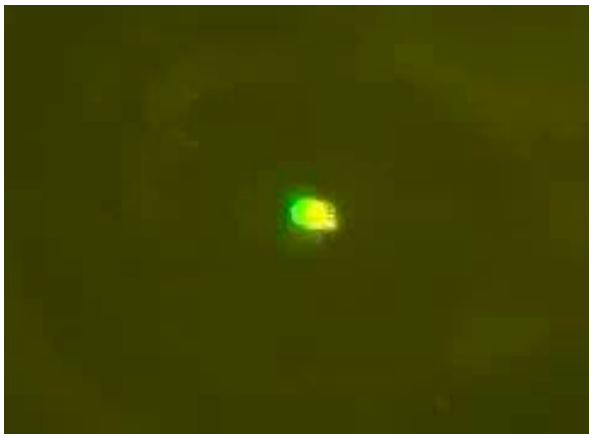


Node movement

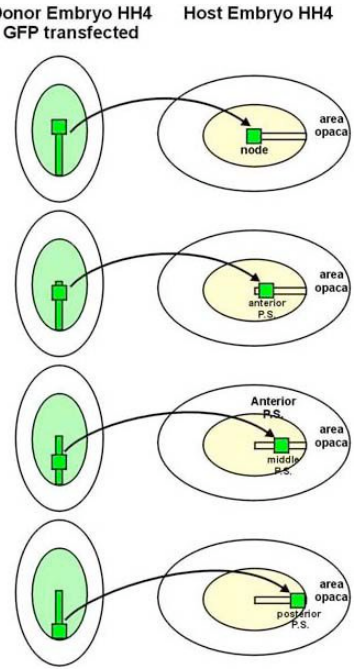


Transplants during chick gastrulation

44

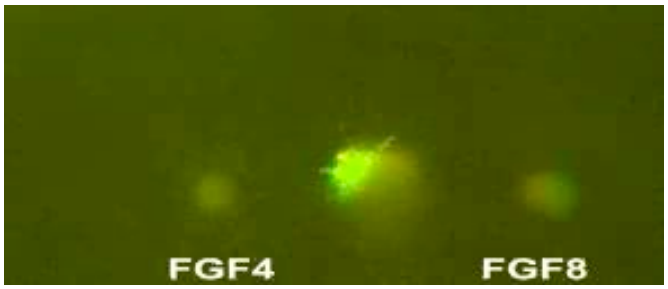


mid-streak movement



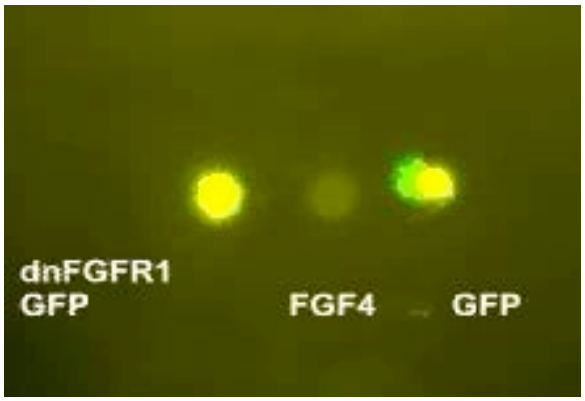
Transplants during chick gastrulation

45

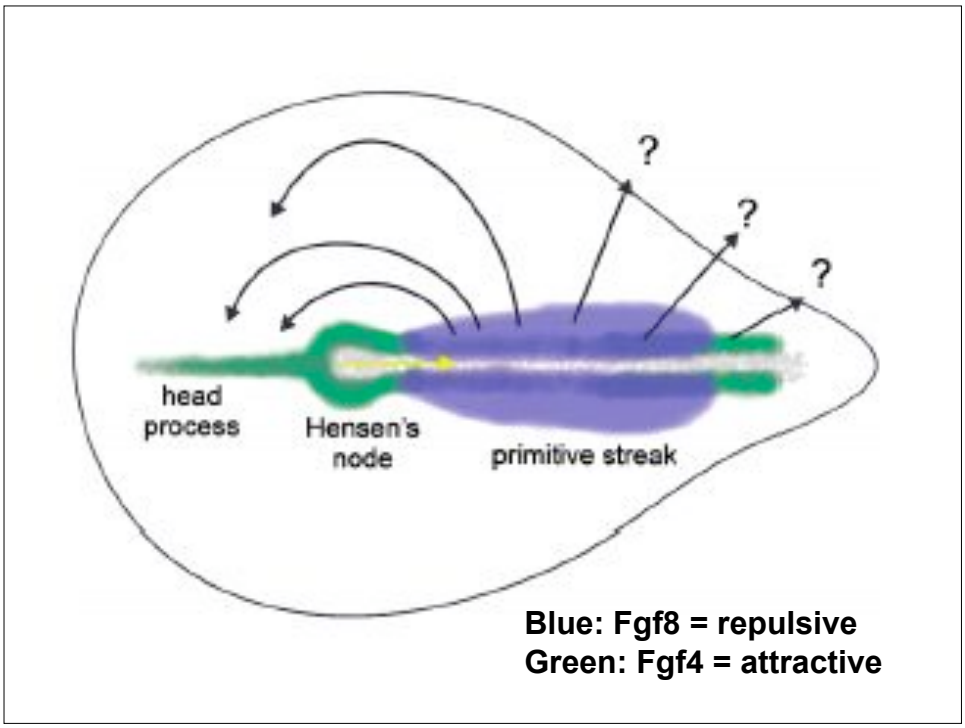


Effects of Fgf4 and Fgf8

46



Requirement for FgfR



Blue: Fgf8 = repulsive
Green: Fgf4 = attractive