Autonomous Specification in

Tunicate development

Autonomous & Conditional Specification in

C. elegans Embryonic Development

Figure 8.36 ***Bilateral Symmetry in the Egg of the Tunicate*** **Styela partita**

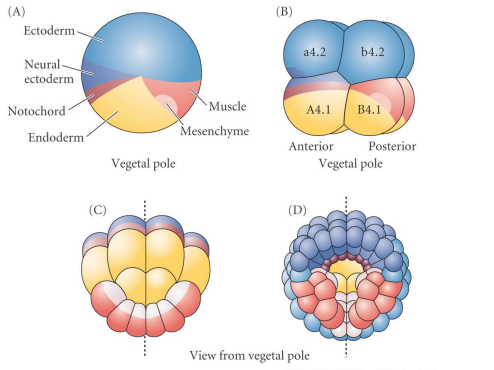

Fig. 8.37 ***Cytoplasmic Rearrangement in the Fertilized Egg of*** **Styela partita**

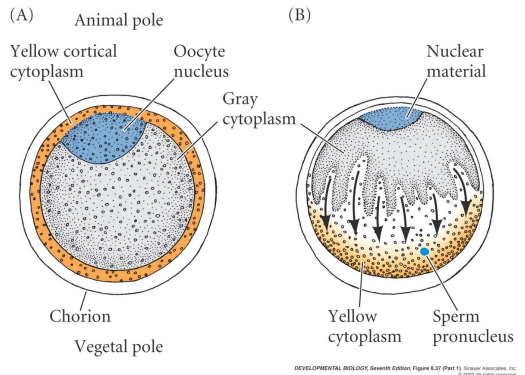

Fig. 8.37 ***Cytoplasmic Rearrangement in the Fertilized Egg of*** **Styela partita**

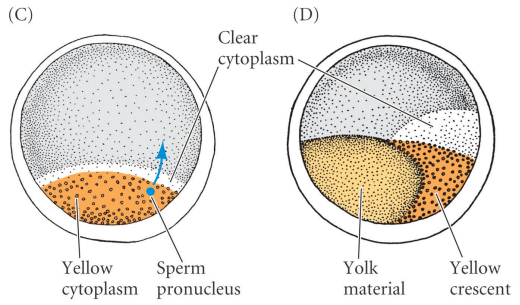

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Figure 8.38(1) ***Cytoplasmic Segregation in the Egg of*** **Styela partita.**

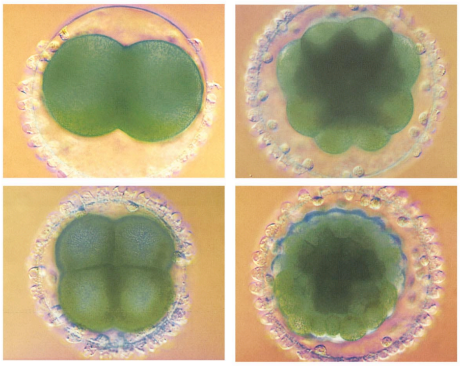

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Figure 3.8 ***Autonomous Specification in the Early Tunicate Embryo***

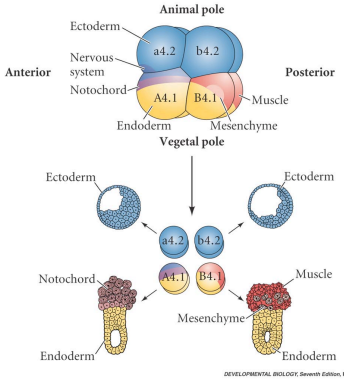

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Figure 3.9 ***Acetylcholinesterase in Progeny of Muscle Lineage Blastomeres***

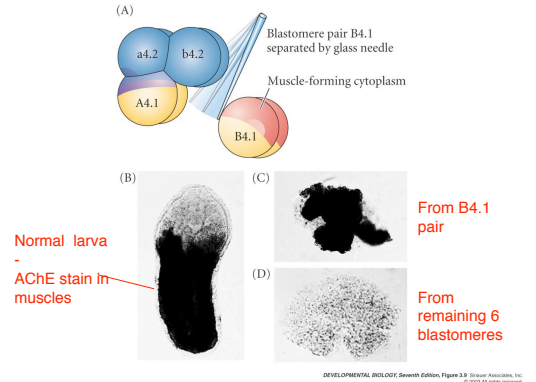


Figure 3.10 ***Microsurgery on Tunicate Eggs***

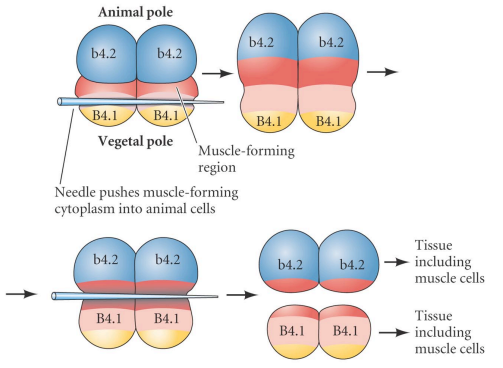
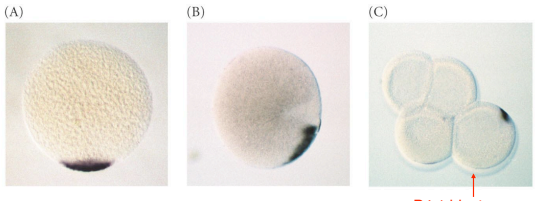


Figure 8.39 ***Autonomous Specification by a Morphogenetic Factor***



macho-1 mRNA localization

Figure 8.41 ***Comparison of Normal Tunicate Embryos and Embryos from which Posterior Vegetal Cytoplasm has been Removed***

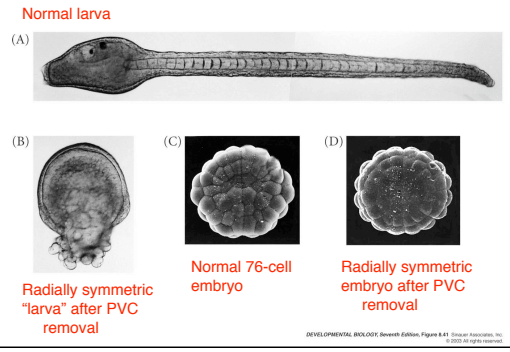
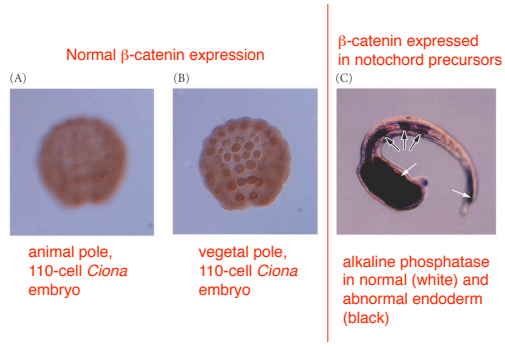


Figure 8.40 ***Antibody Staining of β-catenin Protein Shows Its Involvement with Endoderm Formation***



Caenorhabditis elegans embryonic development

Autonomous specification:

P granule segregation

Endomesoderm specification
- *skn-1* gene function

Conditional specification:

Endomesoderm specification
- Wnt signaling

Figure 8.43(2) ***Caenorhabditis elegans***

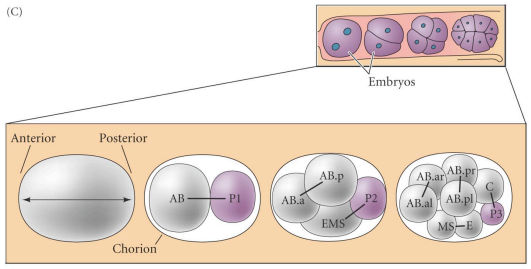
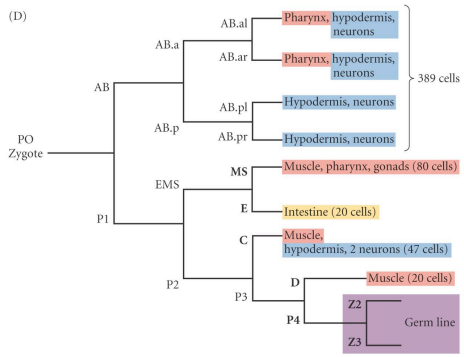
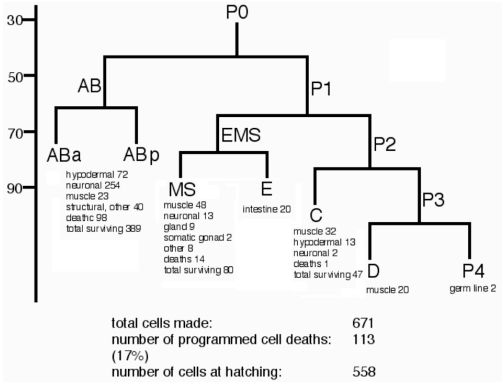


Figure 8.43(3) ***Caenorhabditis elegans*** **early embryonic cell lineage**



NOT Figure 8.43(3) *Caenorhabditis elegans* early embryonic cell lineage



Caenorhabditis elegans complete (embryonic & post-embryonic) cell lineage

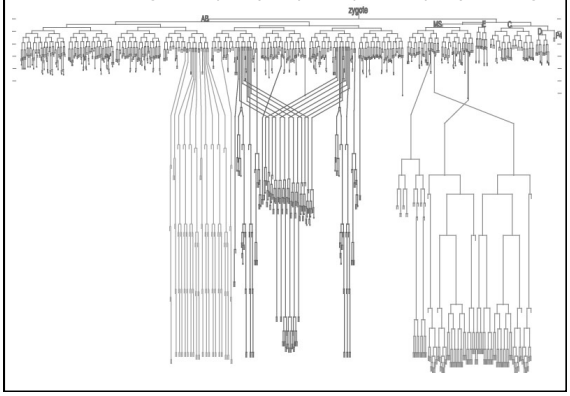


Figure 8.44(1) ***Segregation of the P-granules into the Germ Line Lineage of the*** **C. elegans** ***Embryo***

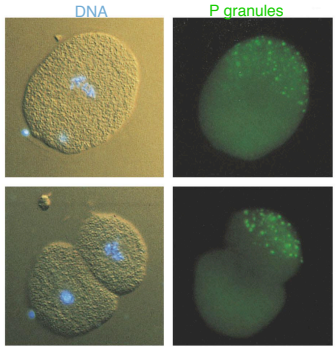


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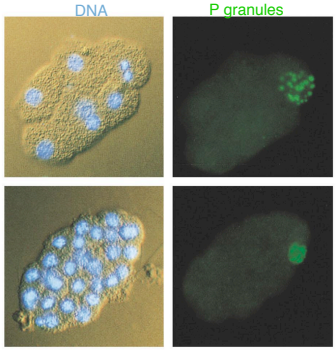
Figure 8.44(2) ***Segregation of the P-granules into the Germ Line Lineage of the*** **C. elegans** ***Embryo***



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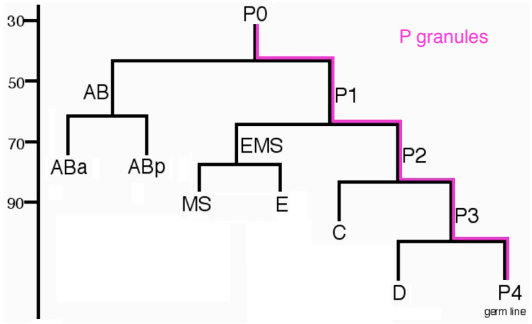
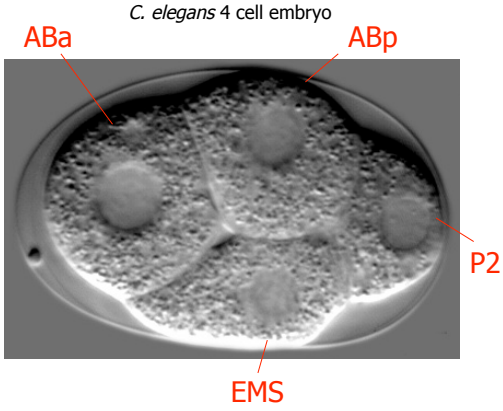
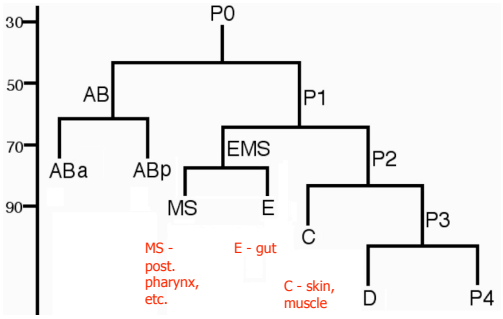
Segregation of the P-granules into the Germ Line Lineage



C. elegans 4 cell embryo

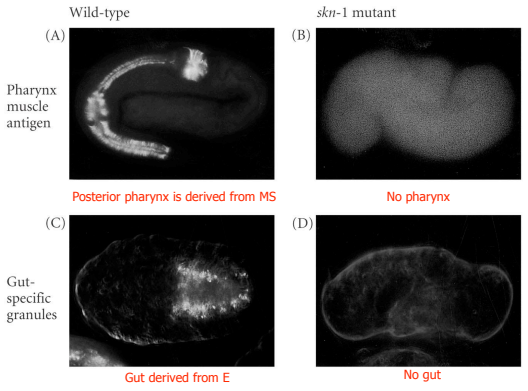


Autonomous specification of cell lineages

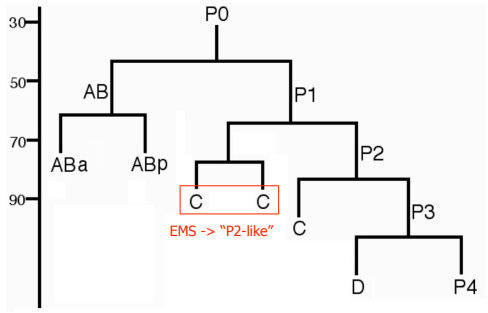


Normal cell lineage

Figure 8.45 ***Deficiencies of Intestine and Pharynx in*** **Skn-1** ***Mutants of*** **C. elegans**

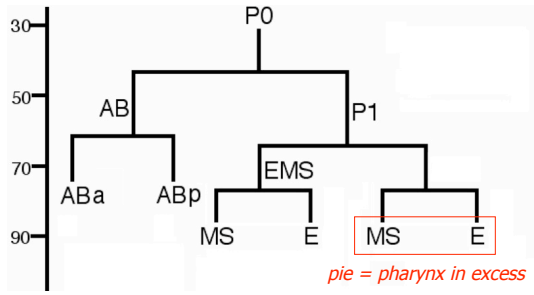


Transformation of EMS blastomere into P2-like cell



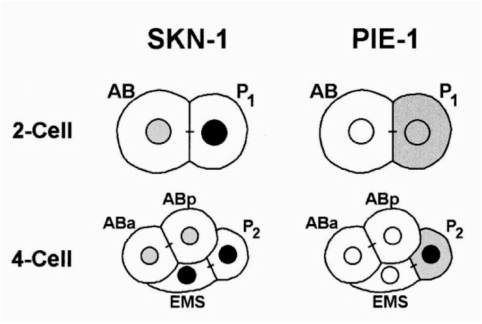
Fate transformation in progeny of *skn-1(-/-)* mothers (maternal effect)

Transformation of P2 blastomere into EMS-like cell



Fate transformation in progeny of *pie-1(-/-)* mothers (maternal effect)

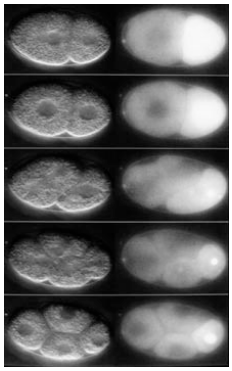
Normal segregation of Skn-1 & Pie-1 proteins in EMS & P2



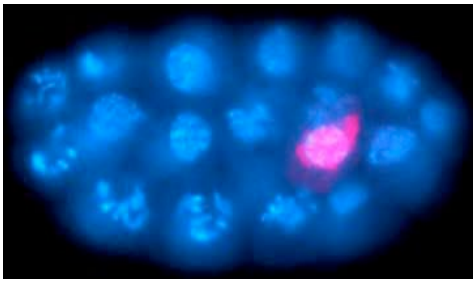
Skn-1 is a bZIP TF

Pie-1 is also a TF

Segregation of Pie-1 protein into P cell germ line precursors



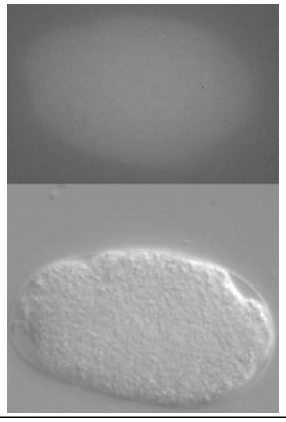
Segregation of Pie-1 protein into P cell germ line precursors



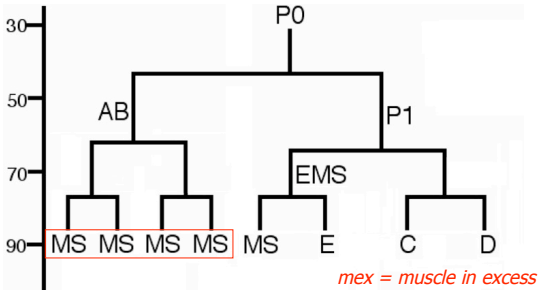
Blue: DAPI (nuclei) **Red: Pie-1 protein**

Pie-1 is a component of P granules

Segregation of Pie-1 movie



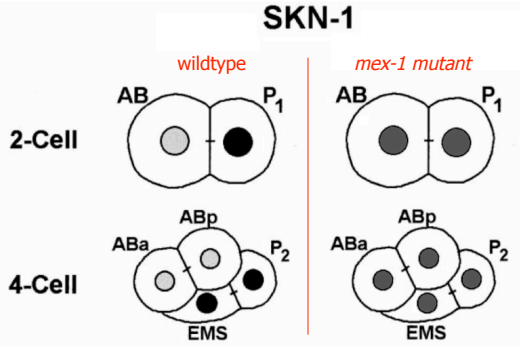
Transformation of blastomeres in *mex-1* mutants



mex = muscle in excess

Fate transformation in progeny of *mex-1(-/-)* mothers (maternal effect)

Misregulation of Skn-1 protein in *mex-1* mutant embryos



Mex-1 is a TF

Caenorhabditis elegans embryonic development

Endomesoderm specification also depends on cell-cell signaling

P2 signals EMS to promote endoderm formation in one of its progeny (E)

Figure 8.46 ***Experiments Show that Cell-Cell Interactions Are Required for the EMS Cell to Form Intestinal Lineage Determinants***

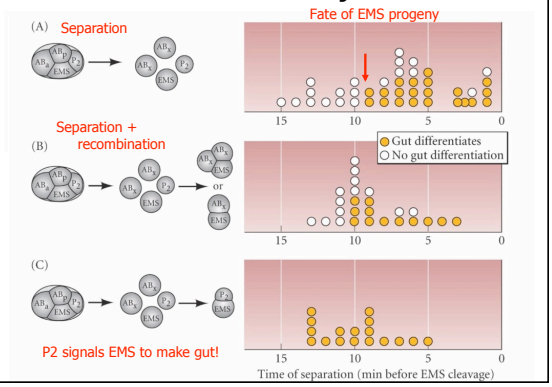
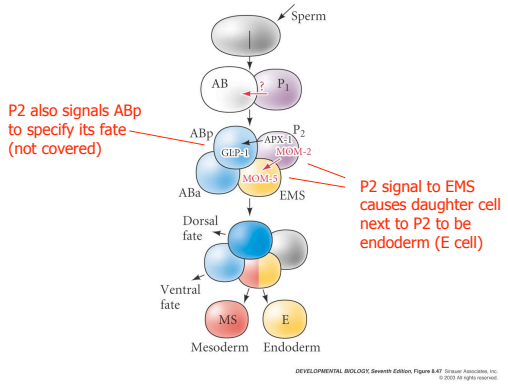
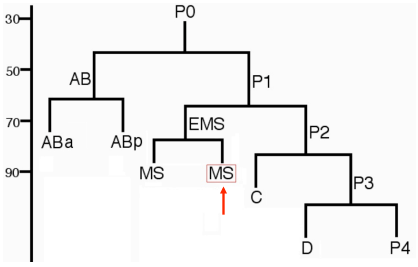


Figure 8.47 ***Cell-Cell Signaling in the 4-Cell Embryo of*** **C. elegans**



***C. elegans* Wnt signaling pathway in blastomere specification**

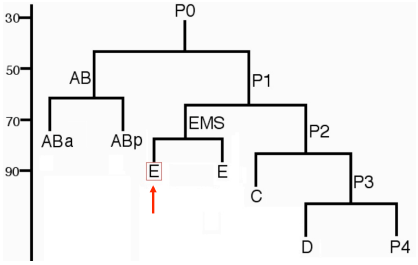
Maternal effect mutants affecting P2 -> EMS signal:



Mom - "*m*ore of *M*S" (E transformed to MS)

***C. elegans* Wnt signaling pathway in blastomere specification**

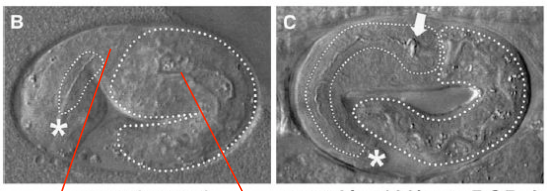
Maternal effect mutants affecting P2 -> EMS signal:



Pop - "*po*sterior *p*harynx defect" - opposite phenotype to Mom (MS transformed to E)

***pop-1* mutant embryo phenotype**

mutant embryo wild type embryo



pop-1(zu189) ***pop-1(zu189); mgPOP-1***

posterior pharynx missing

excess gut

C. elegans Wnt signaling pathway in blastomere specification

P2 to EMS signal uses a Wnt signaling pathway

Mom-2	Wnt-like (secreted signal from P2)
Mom-5	Frizzled (receptor)
Gsk-3	GSK3 (kinase)
Wrm-1	β-catenin (transcription factor)
Pop-1	TCF (transcription factor)

No apparent Dishevelled (Dsh) homolog

Canonical vs. Worm Embryo comparison of the Wnt Pathway

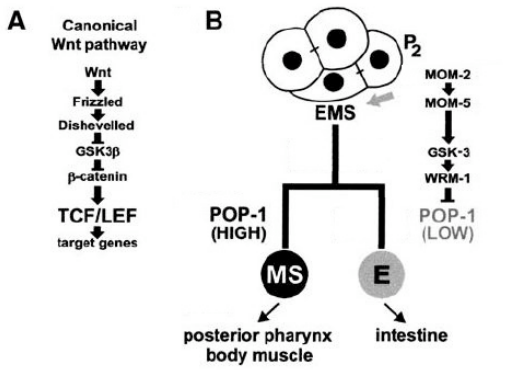
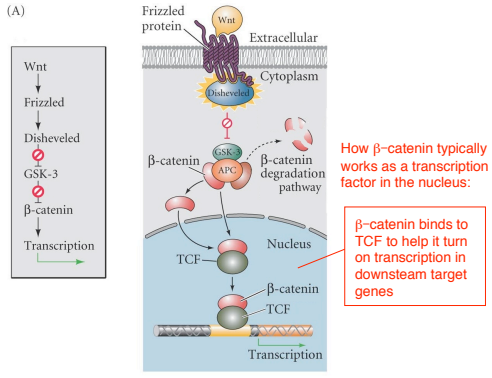


Fig. 6.24(1) ***The Wnt Signal Transduction Pathway***

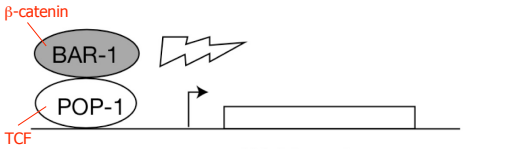


How β-catenin typically works as a transcription factor in the nucleus:

β-catenin binds to TCF to help it turn on transcription in downsteam target genes

Wnt Signaling in C. elegans *vulval development*

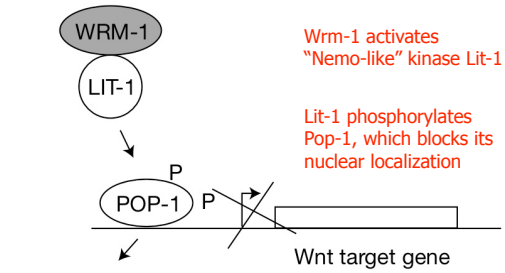
Wnt signaling in vulval development is canonical:
BAR-1 binds and activates POP-1 (TCF homolog)



BAR-1/POP-1 complex turns on downstream target genes

Non-canonical Wnt Signaling in C. elegans *embryogenesis*

The β-catenin homolog Wrm-1 works differently in embryonic Wnt signaling pathway:

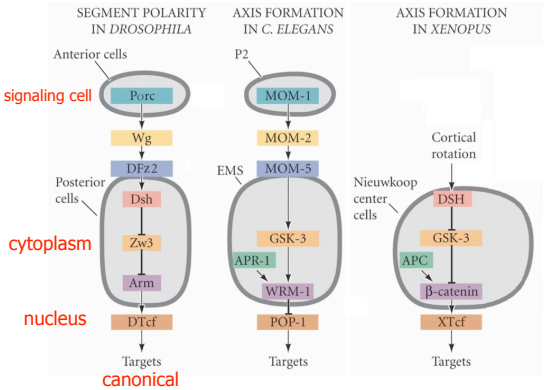


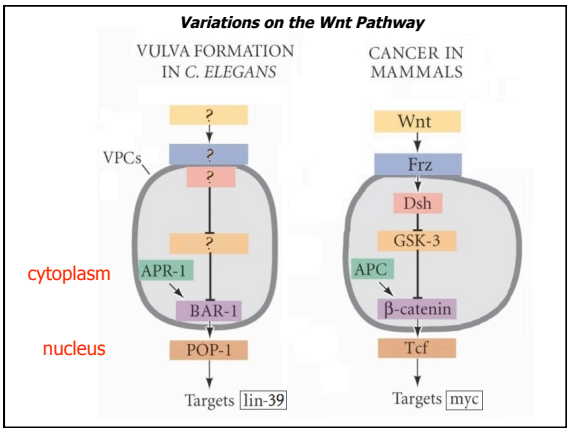
Wrm-1 activates "Nemo-like" kinase Lit-1

Lit-1 phosphorylates Pop-1, which blocks its nuclear localization

Loss of nuclear localization

Variations on the Wnt Pathway




Variations on the Wnt Pathway
VULVA FORMATION IN C. ELEGANS
CANCER IN MAMMALS
VPCs
?
?
?
?
APR-1
BAR-1
POP-1
Targets lin-39
Wnt
Frz
Dsh
GSK-3
APC
β-catenin
Tcf
Targets myc
cytoplasm
nucleus