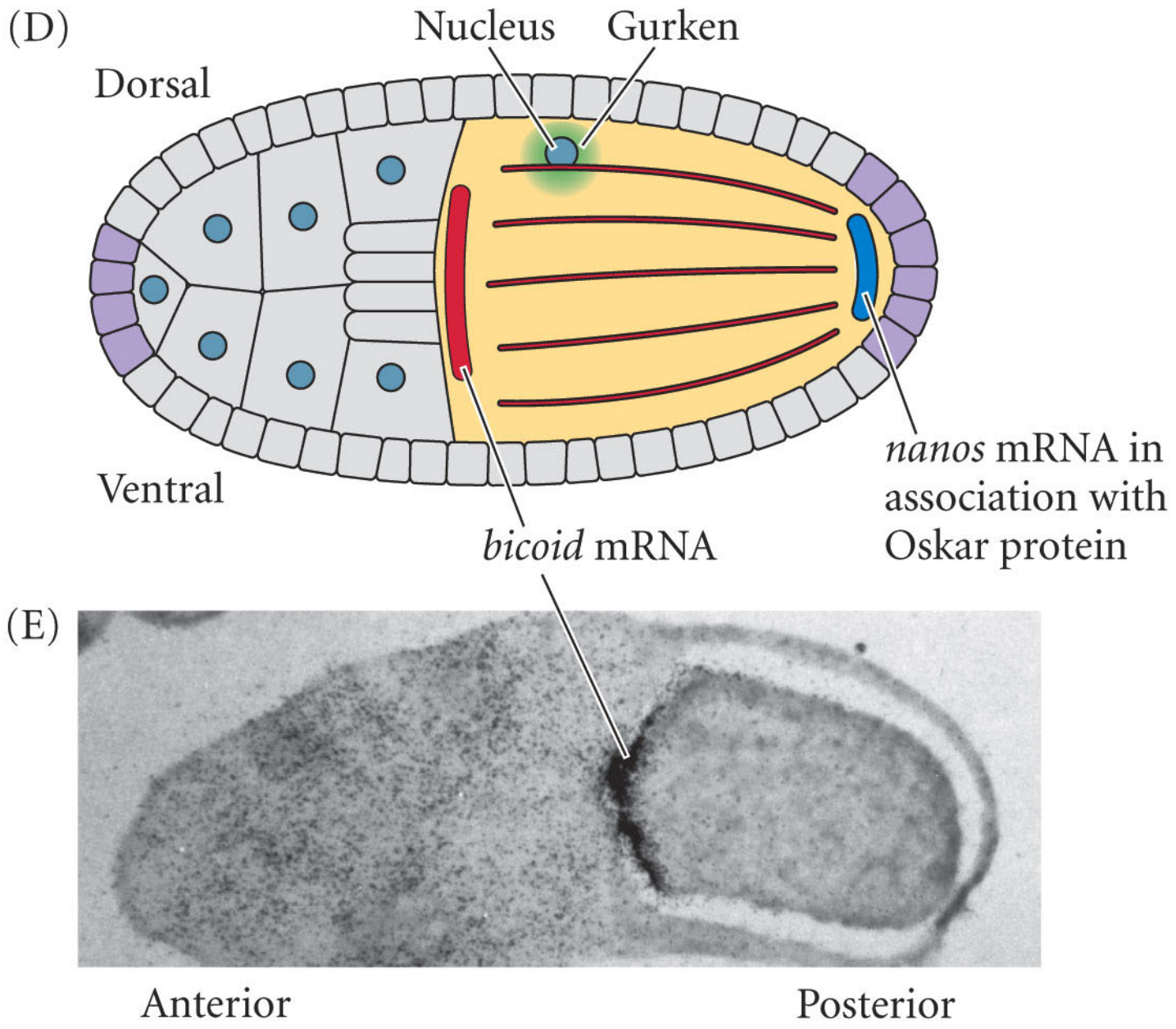
9.8 The anterior-posterior axis is specified during oogenesis (Part 3)



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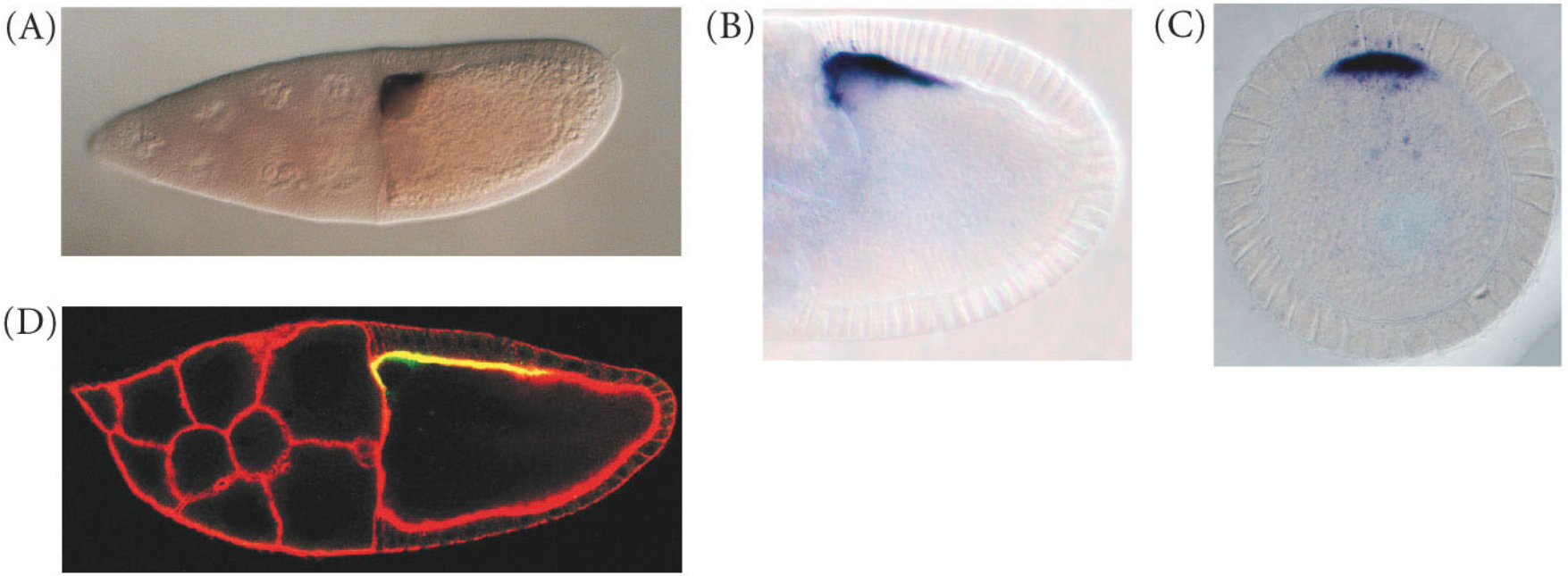
9.9 Expression of the *gurken* message and protein between the oocyte nucleus and the dorsal anterior cell membrane



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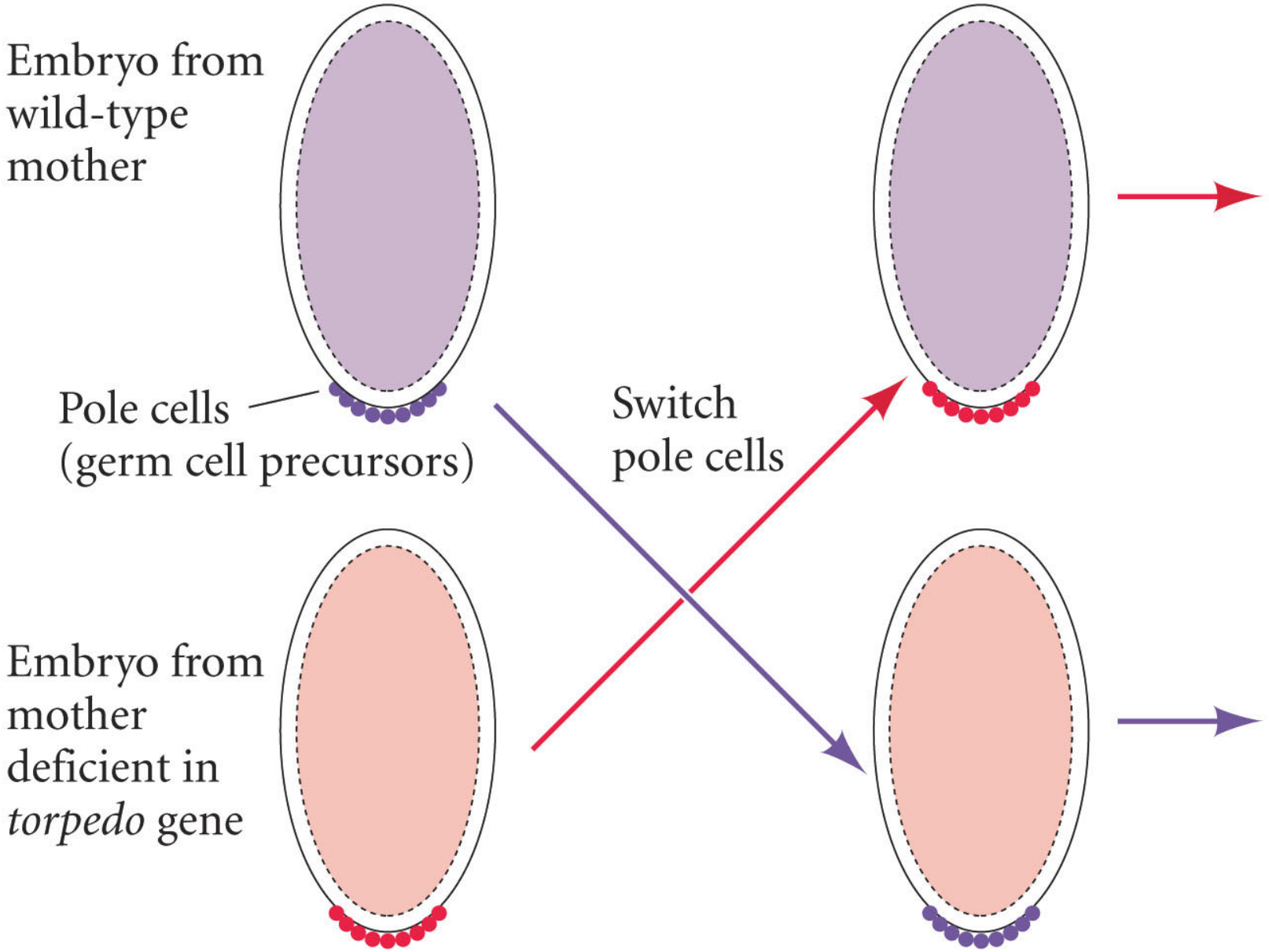
9.10 Germline chimeras made by interchanging pole cells between wild-type embryos and embryos from mothers homozygous for a mutation of the *torpedo* gene (Part 1)



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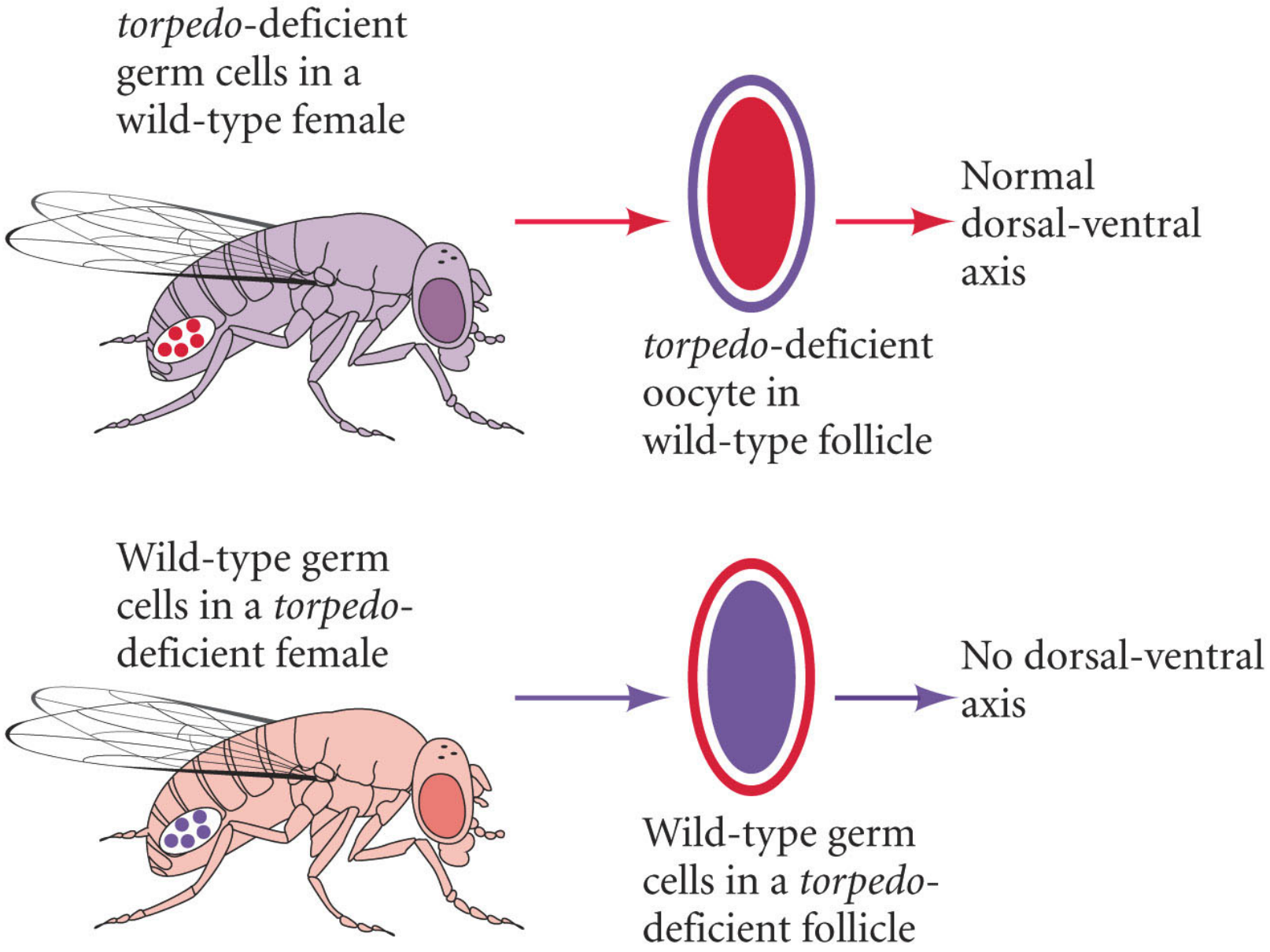
9.10 Germline chimeras made by interchanging pole cells between wild-type embryos and embryos from mothers homozygous for a mutation of the *torpedo* gene (Part 2)



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9.12 Effect of mutations affecting the distribution of the Dorsal protein

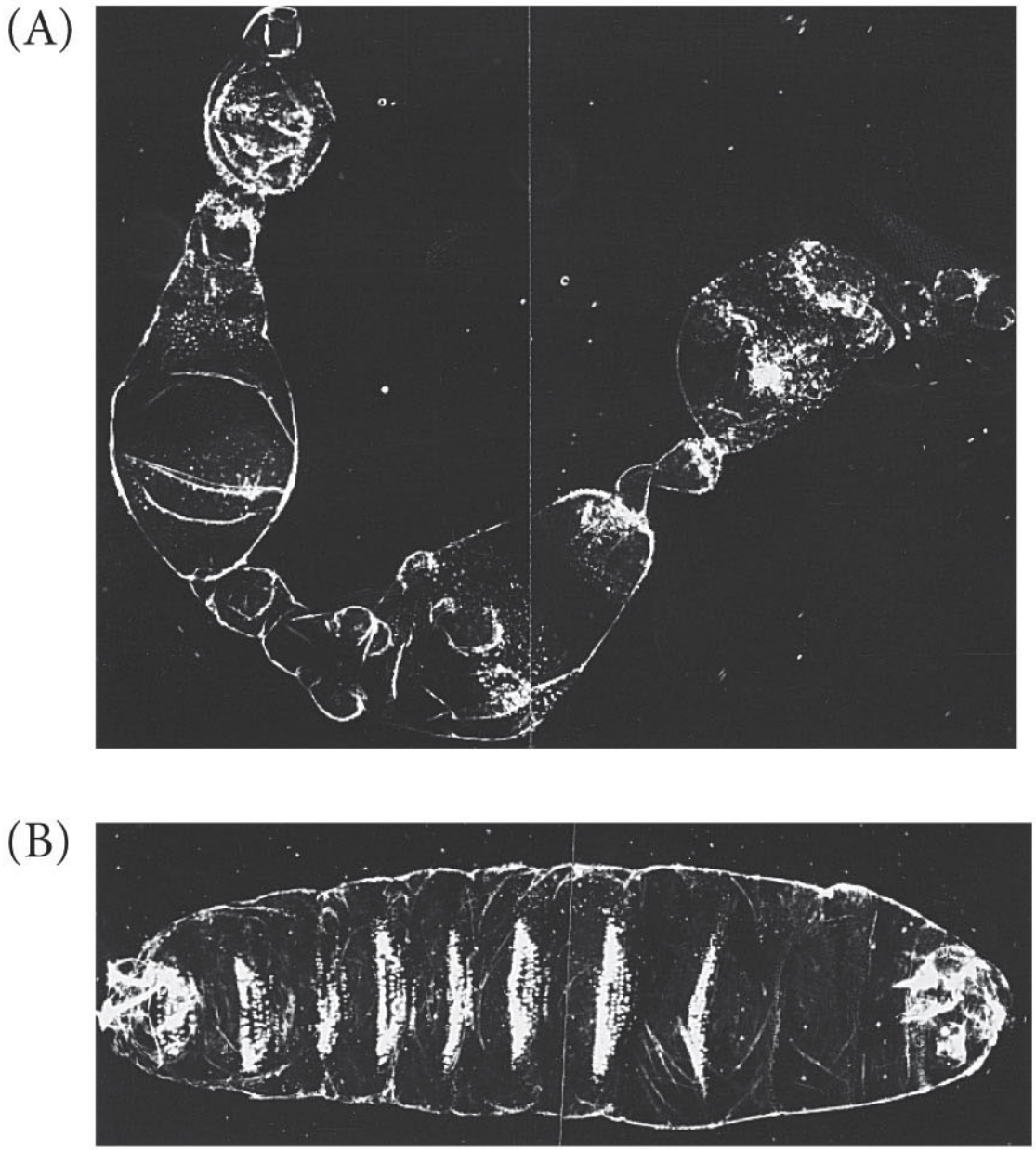

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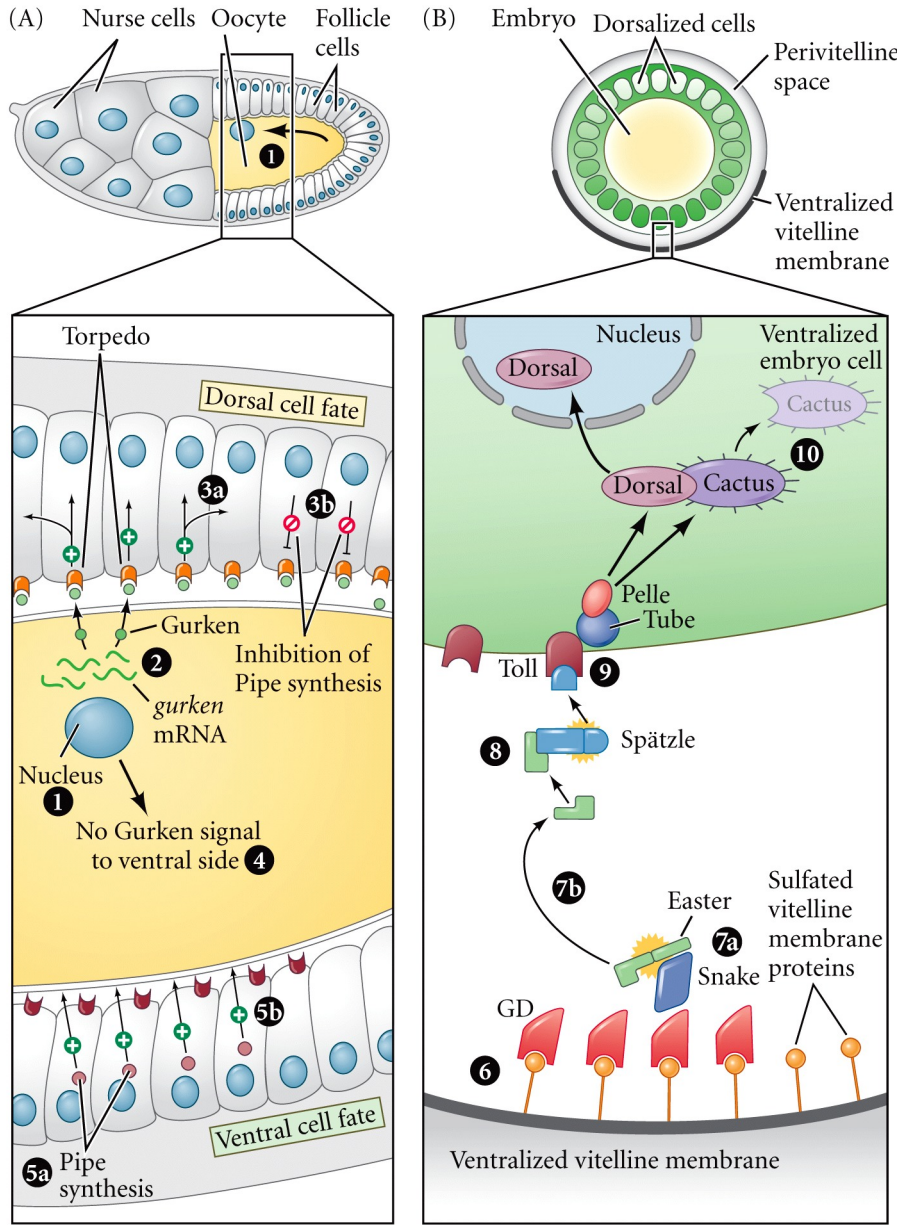
Figure 6.11 Generating dorsal-ventral polarity in *Drosophila*



1. Oocyte nucleus travels to anterior dorsal side of oocyte where it localizes *gurken* mRNA.
2. Translated Gurken is received by Torpedo proteins.
3a. Torpedo signal causes follicle cells to differentiate to a dorsal morphology.
3b. Pipe synthesis is inhibited in dorsal follicle cells.
4. Gurken does not diffuse to ventral follicle cells.
5a. Ventral follicle cells synthesize Pipe.
5b. Pipe signal sulfates ventral vitelline proteins.
6. Sulfated vitelline membrane proteins bind Gastrulation-defective (GD).
7a. GD cleaves Snake to its active form and forms a complex with Snake and uncleaved Easter proteins.
7b. Easter protein is cleaved into its active form.
8. Cleaved Easter binds to and cleaves Spätzle; activated Spätzle binds to Toll receptor protein.
9. Toll activation activates Tube and Pelle, which phosphorylate the Cactus protein. Cactus is degraded, releasing it from Dorsal.
10. Dorsal protein enters the nucleus and ventralizes the cell.

***DEVELOPMENTAL BIOLOGY 10e*, Figure 6.11**

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9.11 Generating dorsal-ventral polarity in *Drosophila* (Part 2)

1. Oocyte nucleus travels to anterior dorsal side of oocyte where it localizes *gurken* mRNA.
2. *gurken* messages are translated. Gurken is received by Torpedo proteins during mid-oogenesis.
3a. Torpedo signal causes follicle cells to differentiate to a dorsal morphology.
3b. Synthesis of Pipe is inhibited in dorsal follicle cells.
4. Gurken does not diffuse to ventral side.
5. Ventral follicle cells synthesize Pipe.
6. In ventral follicle cells, Pipe completes the modification of an unknown factor (x).
7. Nudel and factor (x) interact to split the Gastrulation-deficient (Gd) protein.
8. Activated Gd splits the Snake protein, and activated Snake cleaves the Easter protein.
9. Activated Easter splits Spätzle; activated Spätzle binds to Toll receptor protein.
10. Toll activation activates Tube and Pelle, which phosphorylate the Cactus protein. Cactus is degraded, releasing it from Dorsal.
11. Dorsal protein enters the nucleus and ventralizes the cell.

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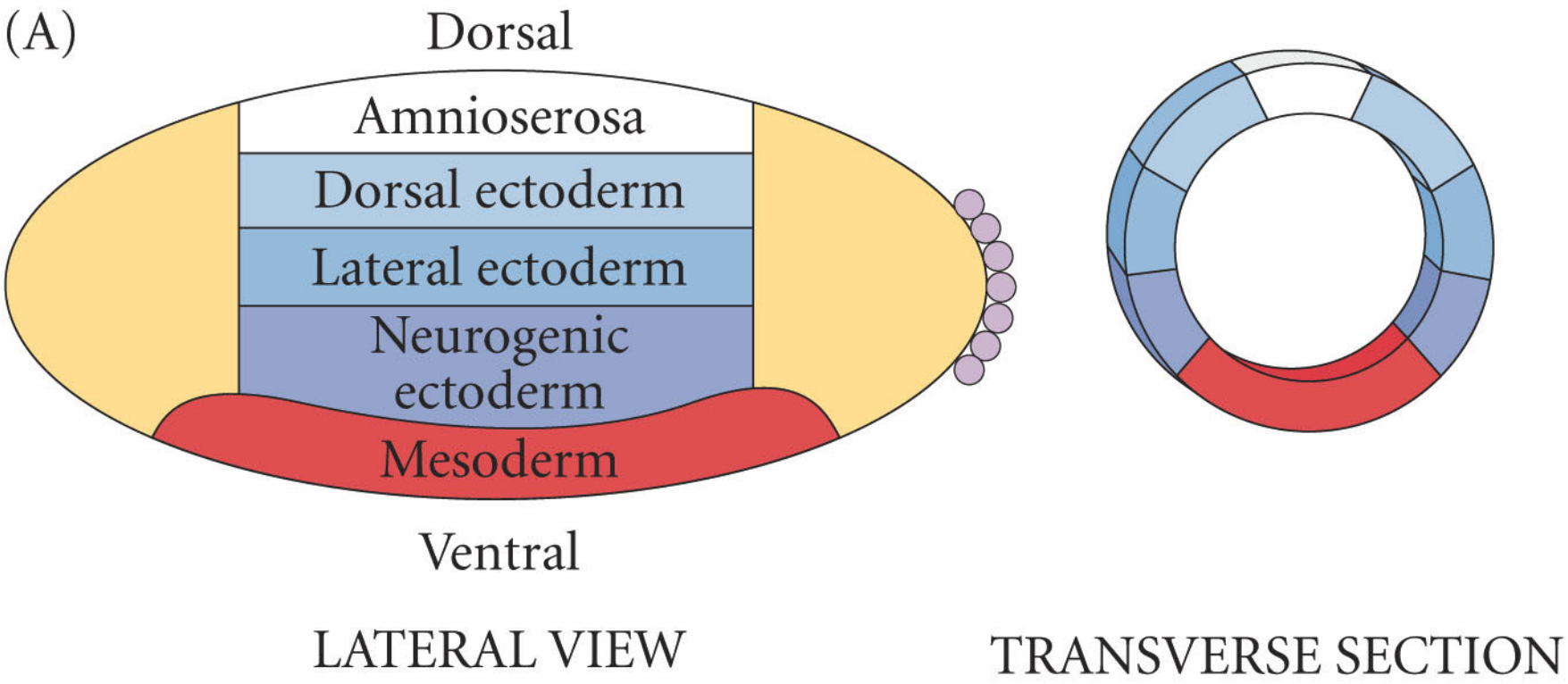
9.13 Translocation of Dorsal protein into ventral, but not lateral or dorsal, nuclei (Part 1)



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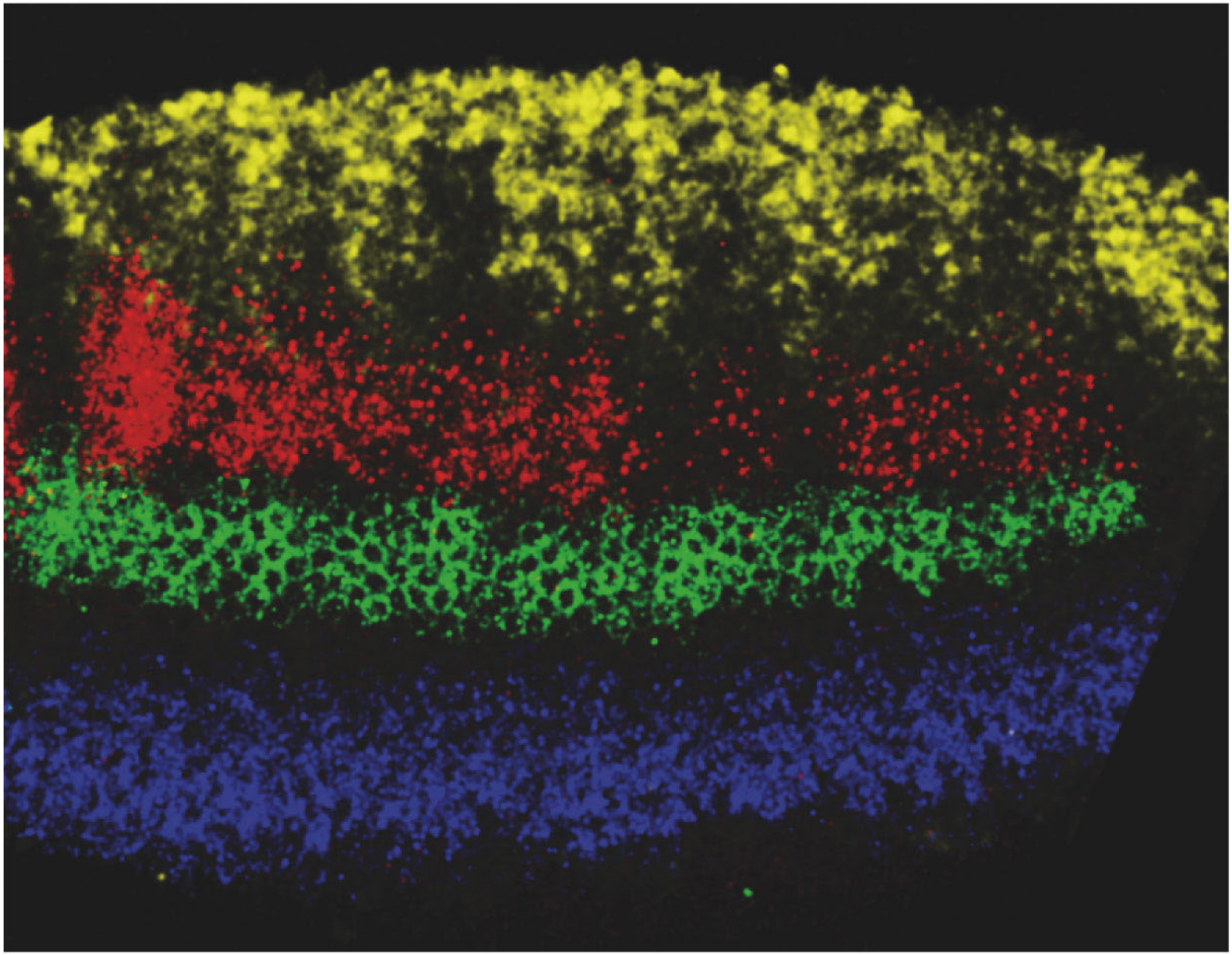
9.16 Dorsal-ventral patterning in *Drosophila*



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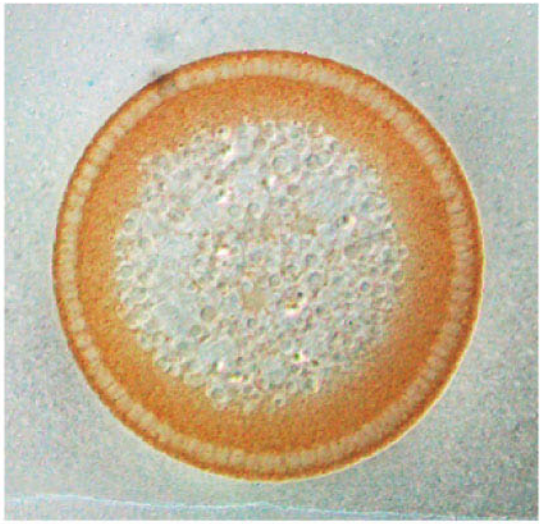
9.13 Translocation of Dorsal protein into ventral, but not lateral or dorsal, nuclei (Part 2)

(B)

(C)



(D)

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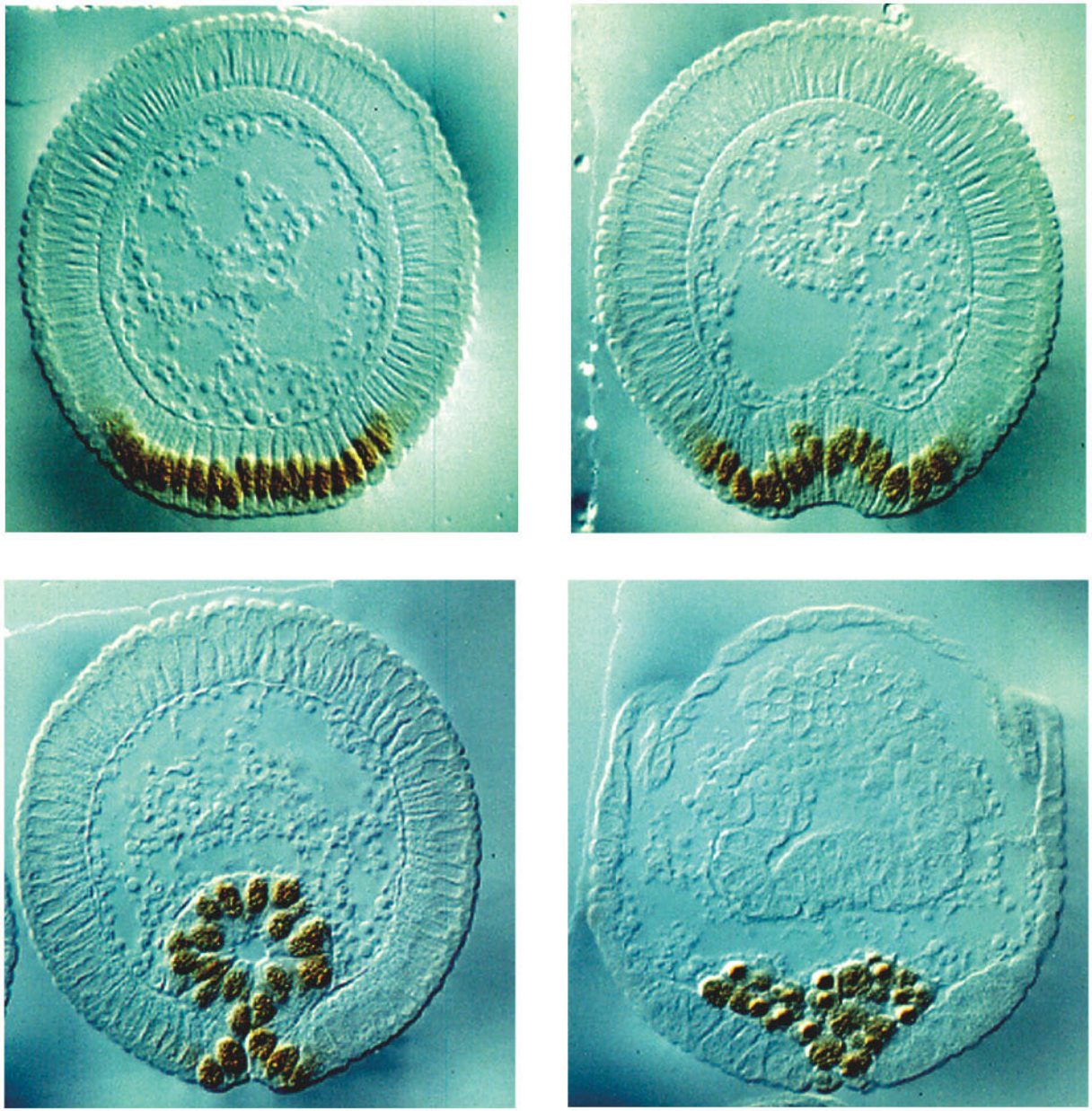
9.14 Gastrulation in *Drosophila*



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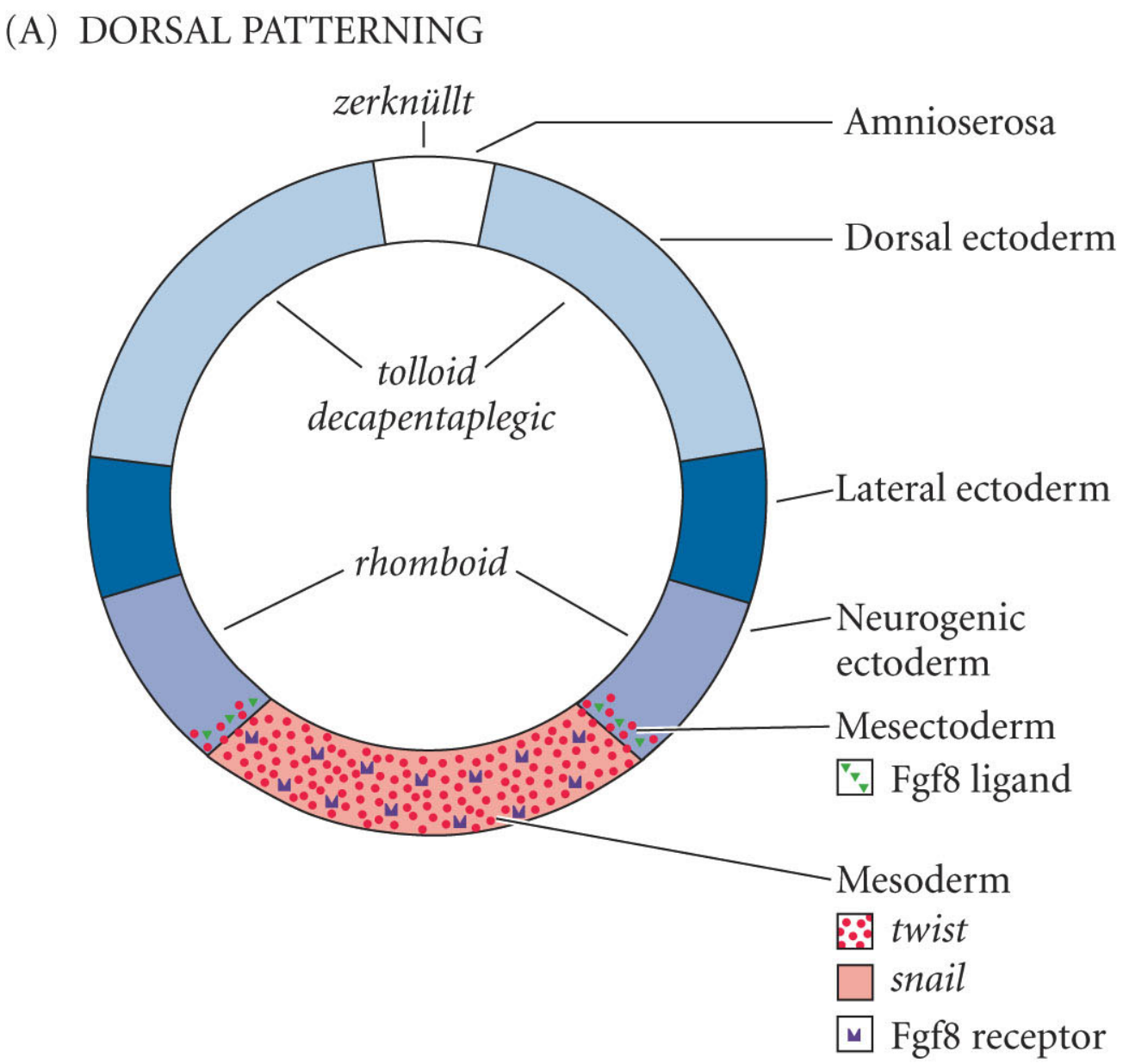
9.15 Subdivision of the *Drosophila* dorsal-ventral axis by the gradient of Dorsal protein in the nuclei (Part 1)



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9.15 Subdivision of the *Drosophila* dorsal-ventral axis by the gradient of Dorsal protein in the nuclei (Part 2)

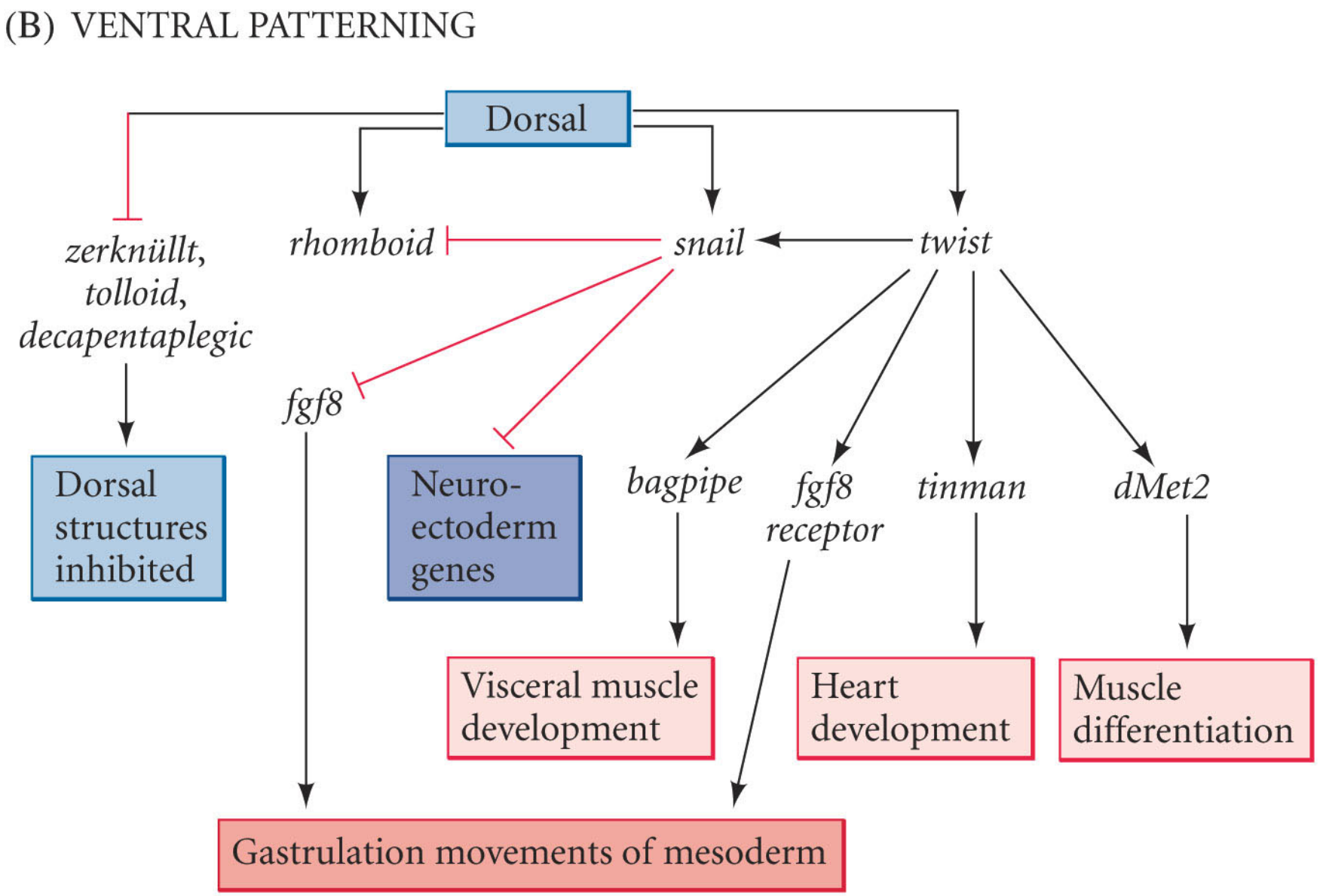

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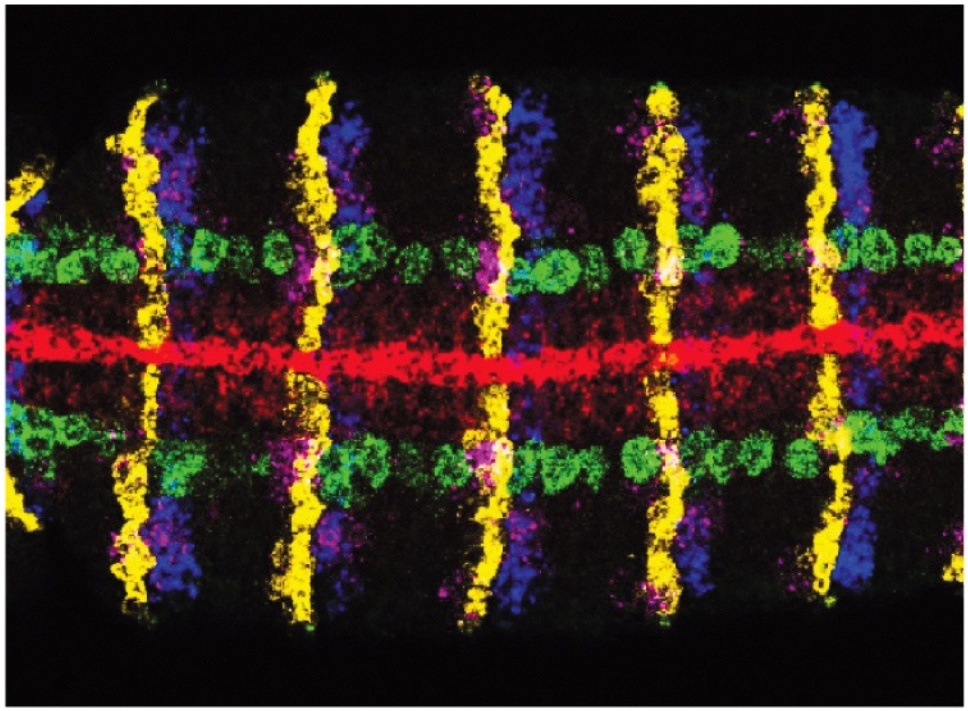
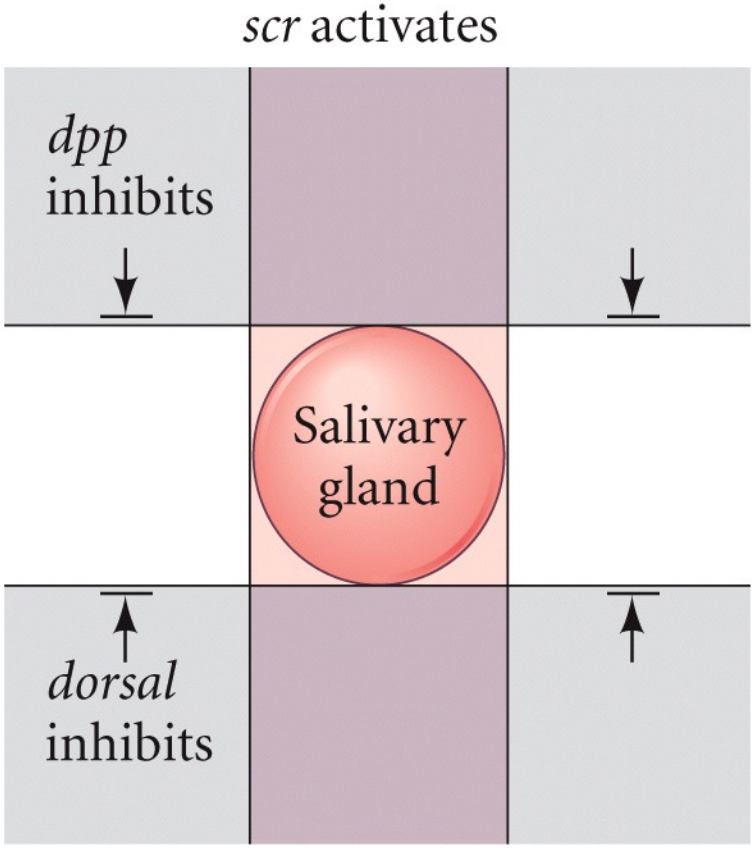
Figure 6.40 Cartesian coordinate system mapped out by gene expression patterns

(A)



(B)



***DEVELOPMENTAL BIOLOGY 10e*, Figure 6.40**

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TABLE 9.1 **Maternal effect genes that effect the anterior–posterior polarity of the *Drosophila* embryo** (Part 1)

Gene	Mutant phenotype	Proposed function and structure
ANTERIOR GROUP		
bicoid (bcd)	Head and thorax deleted, replaced by inverted telson	Graded anterior morphogen; contains homeodomain; represses *caudal* mRNA
exuperantia (exu)	Anterior head structures deleted	Anchors *bicoid* mRNA
swallow (swa)	Anterior head structures deleted	Anchors *bicoid* mRNA
POSTERIOR GROUP		
nanos (nos)	No abdomen	Posterior morphogen; represses *hunchback* mRNA
tudor (tud)	No abdomen, no pole cells	Localization of Nanos protein
oskar (osk)	No abdomen, no pole cells	Localization of Nanos protein
vasa (vas)	No abdomen, no pole cells; oogenesis defective	Localization of Nanos protein
valois (val)	No abdomen, no pole cells; cellularization defective	Stabilization of the Nanos localization complex
pumilio (pum)	No abdomen	Helps Nanos protein bind *hunchback* message
caudal (cad)	No abdomen	Activates posterior terminal genes

Source: After Anderson 1989.

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TABLE 9.1 **Maternal effect genes that effect the anterior–posterior polarity of the *Drosophila* embryo** (Part 2)

Gene	Mutant phenotype	Proposed function and structure
TERMINAL GROUP		
torso (tor)	No termini	Possible morphogen for termini
trunk (trk)	No termini	Transmits Torso-like signal to Torso
fs(1)Nasrat[fs(1)N]	No termini; collapsed eggs	Transmits Torso-like signal to Torso
fs(1)polehole[fs(1)ph]	No termini; collapsed eggs	Transmits Torso-like signal to Torso

Source: After Anderson 1989.

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TABLE 9.2 Major genes affecting segmentation pattern in *Drosophila*

Category	Gene name	
Gap genes	*Krüppel (Kr)*	*huckebein (hkb)*
	knirps (kni)	*buttonhead (btd)*
	hunchback (hb)	*empty spiracles (ems)*
	giant (gt)	*orthodenticle (otd)*
	tailless (tll)	
Pair-rule genes (primary)	*hairy (h)*	
	even-skipped (eve)	
	runt (run)	
Pair-rule genes (secondary)	*fushi tarazu (ftz)*	*sloppy-paired (slp)*
	odd-paired (opa)	*paired (prd)*
	odd-skipped (odd)	
Segment polarity genes	*engrailed (en)*	*armadillo (arm)*
	wingless (wg)	*patched (ptc)*
	cubitus interruptusD (ciD)	*gooseberry (gsb)*
	hedgehog (hh)	*pangolin (pan)*
	fused (fu)	

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