OUTLINE 7

VII. Mechanisms of Animal Development
   A. Cytoplasmic determinants
      1. axes of symmetry in amphibians
      2. bicoid gene in Drosophila
   B. Cell communication
      1. Holtfreter’s work
      2. mechanisms of cell recognition
      3. induction
   C. Morphogens and pattern formation (chick limb bud)
   D. Hormones (in amphibian development)
      1. pattern of metamorphosis
      2. role of thyroxin
      3. evidence
OUTLINE 6

VI. Morphogenesis

A. General features of gastrulation

B. Cell movement
   1. extension and contraction
   2. adhesion

C. Gastrulation in the sea urchin

D. Gastrulation in the frog

E. Three layers of cells
   1. ectoderm
   2. mesoderm
   3. endoderm

F. Neurulation
Gastrulation in the Sea urchin
Fig. 47.10

Gastrulation in the frog

KEY
- Future ectoderm
- Future endoderm
- Future mesoderm

1. Animal pole
   Vegetal pole
   Blastula

2. GASTRULATION
   Dorsal lip of blastopore
   Dorsal lip of blastopore

3. Blastocoel shrinking
   Archenteron

4. Ectoderm
   Mesoderm
   Endoderm

Gastrula

Yolk plug

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Frog gastrulation (cross section)

QuickTime™ and a Microsoft Video 1 decompressor are needed to see this picture.
Fig. 47.16  Changes in cell shape during morphogenesis
Neurulation in the frog
Gastrulation and neurulation in the frog

QuickTime™ and a Cinepak decompressor are needed to see this picture.
Determination of axes of symmetry in the frog

Fig. 47.7

- Animal hemisphere
- Vegetal hemisphere
- Animal pole
- Point of sperm entry
- Vegetal pole
- First cleavage plane

Rotation of cell cortex

Gray crescent (exposed nonpigmented cytoplasm)

Anterior
Right
Ventral
Dorsal
Left
Posterior

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Fig. 21.23

Development in the fly
Fig. 21.24

Determination of anterior-posterior axis in the fly

(a) *Drosophila* larvae with wild-type and bicoid mutant phenotypes

1. Developing egg cell
2. *Bicoid* mRNA in mature unfertilized egg
3. Bicoid protein in early embryo

(b) Gradients of *bicoid* mRNA and protein in normal egg and early embryo

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1. dissociation

2. reaggregation

3. resegregation

ectoderm  □  mesoderm  ●  endoderm  △

Holtfretter 1955
Fig. 47.22 Spemann and Mangold: an organizer
Fig. 47.24  Pattern formation: the chick limb bud

(a) Apical epidermal ridge

(b) Anterior, Ventral, Proximal, Dorsal, Distal, Posterior

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Pattern formation: the chick limb bud
Tadpole
Aquatic
Gills
Herbivorous
Swimming

Frog
Terrestrial
Lungs
Carnivorous
Jumping

metamorphosis
Comparison of beaks of spadefoot tadpoles

Omnivore

Carnivore
Comparison of digestive systems of spadefoot tadpoles

Carnivore

Omnivore