Massachusetts Institute of Technology
Department of Biology
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Introduction conclusion/Vertebrate development I: dorsoventral axis

1. **Stepwise formation of development**

Naïve cells

Determined/committed cells

Differentiated cells

2. **Determinants**

3. **Inducers (induction)**

4. **Signaling systems (inducers)**

Signal (ligand)

Binds receptor

Receptor is altered: modification/ second messengers/ cascade

And alters cell function via changing

= metabolism, gene expression, shape

Leading to change in fate

5. Model organisms

Premise:

Attributes:

Model organism:

Invertebrate
Drosophila

Caenorhabditis

Vertebrates
Zebrafish

Xenopus

Chicken

Mouse

Human

6. Landmarks in Development

Germ layers

Ectoderm

Mesoderm

Endoderm

Stages

Cleavage (blastula, morula)

Gastrula

Neurula

Tailbud

Important structures

Ectoderm
- Dorsal: neural tube anterior >> posterior
  - Forebrain
  - Midbrain
  - Hindbrain
  - Spinal cord (trunk)
    (tail)
- Ventral: epidermis

Mesoderm
- (Dorsal)
- Axial mesoderm: notochord
- Paraxial mesoderm: somites
- Intermediate mesoderm: kidney
- Lateral mesoderm: limbs
- Ventral mesoderm: blood

Endoderm:
- Intestine (anterior to posterior differences)
- Pancreas (left)
- Spleen (left)
- Liver (right larger)
- Lung

7. Experimental approaches

Hypothesis driven analysis

What is a hypothesis?

How do you test a hypothesis?

Show it= observations to establish correlation
Block it= loss of function experiments to establish necessity
Move it = gain of function experiments to establish sufficiency

Demonstration: using sea urchin Delta as an example

i. Observation: micromeres rescue development of the animal half
ii. Delta in micromeres- what does this mean?

Hypothesis:

Tests:

Fate map: what will cells become?

Decision: when do cells decide?

Dorsoventral axis

Think about superimposition of two different processes
Dorsal determination + germ layer determination >> rough division >> refinement

Dorsal determination
Cortical rotation

betacatenin

Wnt pathway

Tcf3

Germ layer determination
Animal pole

Vegetal pole

Morphogen