

# Developmental genetics - I

Genetics 371B Lecture 29

23 Nov. 1999

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## **The problem** faced by embryos

- ◆ **Cell fate** – determination and differentiation

## **Two solutions** to the problem

How to distinguish between these possibilities?

# Generating positional information

- ◆ Intracellular gradients

- ◆ Cell-cell signaling

**Drosophila** – A model system to study development

Why Drosophila?

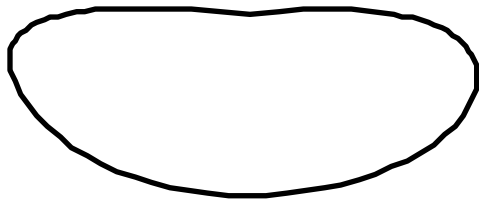
- ◆ large larva

- ◆ rapid development

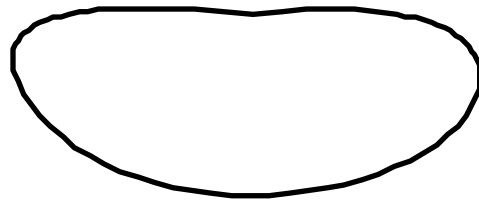
- ◆ molecular biology and genetics

Christiane Nusslein-Volhard  
Eric Wieschaus

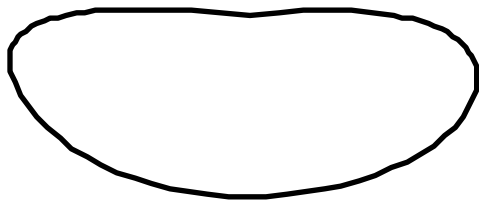
# The early *Drosophila* embryo:



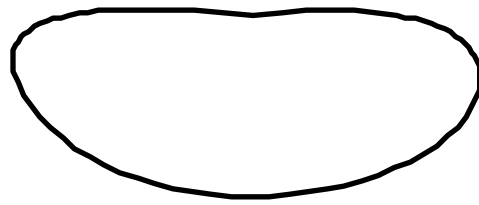
Diploid zygote



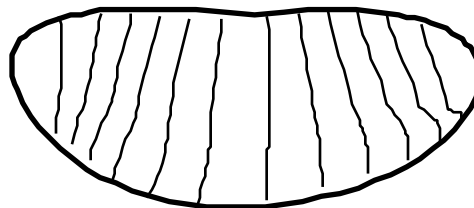
Multinucleate syncytium



Nuclei migrate to surface



Single layer of cells



## **Types of mutants** identified:

- ◆ **Maternal-effect genes** – zygote phenotype determined by maternal genotype

- ◆ e.g., bicoid, nanos, oskar

- ◆ **Interpretation:**

- ◆ **Zygotic genes** – zygote phenotype determined by zygote genotype

- ◆ **Interpretation:**

## **Zygotic gene classes:**

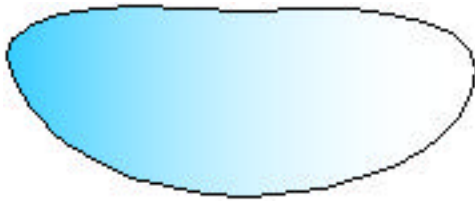
- ◆ **Gap genes** (!) e.g., hunchback, knirps
- ◆ **Pair-rule genes** e.g., fushi-tarazu, even-skipped
- ◆ **Segment polarity genes** e.g., engrailed, hedgehog
- ◆ **Selector (segment identity) genes** e.g.,  
Antennapedia

## **Overall strategy** of body-plan formation:

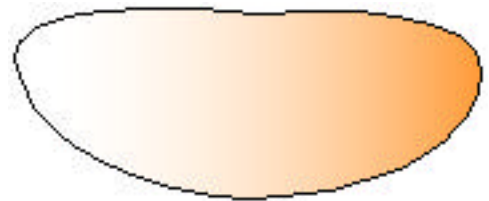
- ◆ Establish polarity
- ◆ Then: combinatorial gene expression

**Step 1.** Establish asymmetry (anterior-posterior, dorsal-ventral)

*bicoid* mRNA –

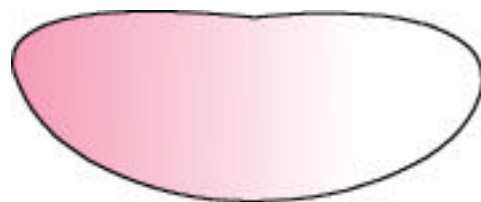


*nanos* mRNA –



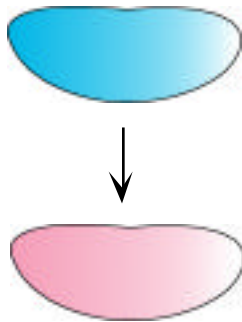
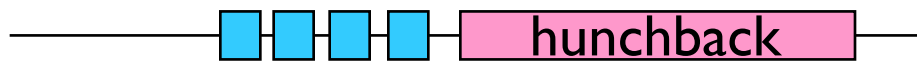
**Step 2.** Read positional information, make broad divisions

*bicoid* → *hunchback* transcription

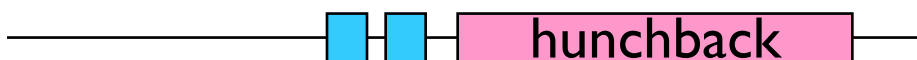


hunchback transcription: dependent on bicoid protein level

- ◆ **Expt. 1:** Overexpress bicoid



- ◆ **Expt. 2:** Reduce # of bicoid binding sites



- ◆ **Expt. 3:** Inject bicoid mRNA into posterior end... your prediction?