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

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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

- **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?