Genetic Control of Development
## Model Organisms for Genetic Studies of Development

<table>
<thead>
<tr>
<th>DROSOPHILA MELANOGASTER (FRUIT FLY)</th>
<th>CAENORHABDITIS ELEGANS (NEMATODE)</th>
</tr>
</thead>
</table>

![Fruit Fly Image](image1)

![Nematode Image](image2)
Model Organisms for Genetic Studies of Development

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<tr>
<th>MUS MUSCULUS (MOUSE)</th>
<th>DANIO RERIO (ZEBRAFISH)</th>
<th>ARABIDOPSIS THALIANA (COMMON WALL CRESS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Mouse Image]</td>
<td>![Zebrafish Image]</td>
<td>![Flowering Plant Image]</td>
</tr>
</tbody>
</table>
Stages of Development in Animals and Plants

(a) Animal development
- Zygote (fertilized egg)
- Eight cells
- Blastula (cross section)
- Gastrula (cross section)
- Gut
- Cell movement
- Adult animal (sea star)

(b) Plant development
- Zygote (fertilized egg)
- Two cells
- Seed leaves
- Embryo inside seed
- Shoot apical meristem
- Root apical meristem
- Plant
Undifferentiated and Differentiated Cells

- Undifferentiated cells retain the ability to develop into any of the body’s cell types
- Differentiated cells will produce certain cell types only
Animal Stem Cells

• Animal stem cells are relatively unspecialized cells that can both reproduce themselves indefinitely and differentiate into specialized cell types.

• Stem cells replenish and generate cells that engage several differentiation pathways; they are present in adult individuals.
Cell Determination and Differentiation

1. Determination

Embryonic precursor cell

Master control gene *myoD*

DNA

OFF

Other muscle-specific genes

OFF

mRNA

MyoD protein (transcription factor)

Myoblast (determined)

2. Differentiation

Muscle cell (fully differentiated)

mRNA

MyoD

Another transcription factor

mRNA

Myosin, other muscle proteins, and cell-cycle blocking proteins
Genes and Pattern Formation

• Pattern formation in animals and plants results from similar genetic and cellular organisms
• Developmental genes are widespreadly conserved
• Homeotic genes, which control the form of anterior and posterior structures of the body, occur in the same sequence in the fruitfly and in mice
Differences in *Hox* Genes Expression