

MODEL ORGANISM

"in situ"

- ① Cell Division
- ② Cell Differentiation
- ③ Morphogenesis.

✱ Differential GENE EXPRESSION results from the genes being regulated differently in each cell type

Cytoplasmic Determinants

- maternal substances in the egg that influence the course of early development.

Inductive Signals

- Signaling molecules from one cell are conveyed by cell surface receptors to induce changes in gene expression through a signal transduction pathway.

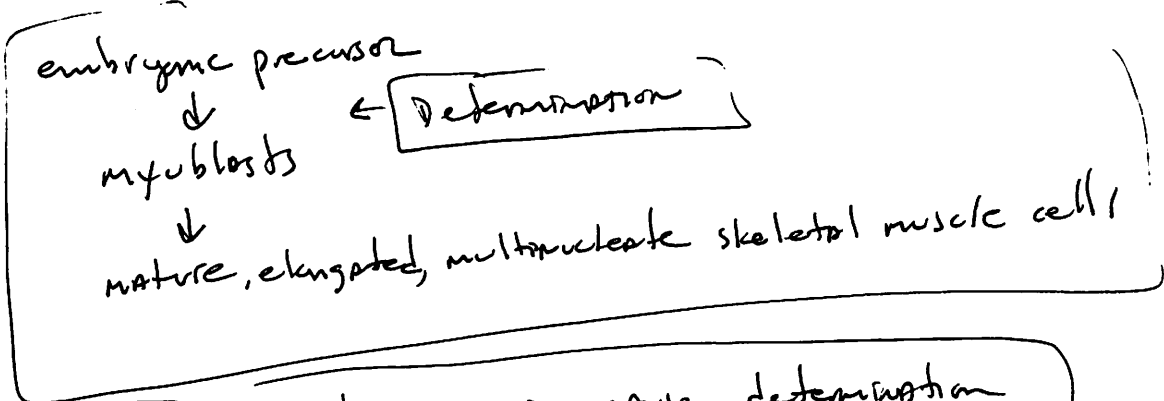
Cell Differentiation

- transcription is the principal regulatory point for maintaining appropriate gene expression.

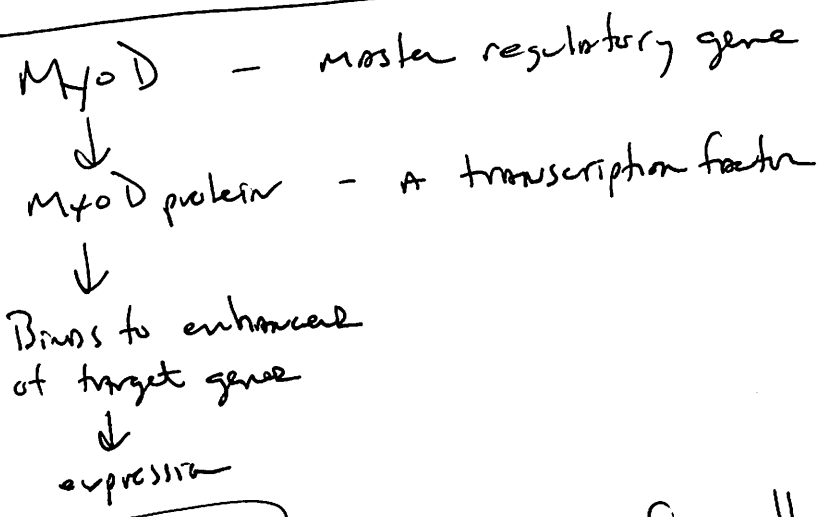
↳ making tissue-specific proteins
 i.e. Liver cells Lens cells
 ↓ ↓
 albumin crystallin

Example - muscle cells

↳ multiple nuclei
 high concentration of contractile proteins myosin & actin
 ↳ membrane receptor proteins.



master regulatory gene cause determination

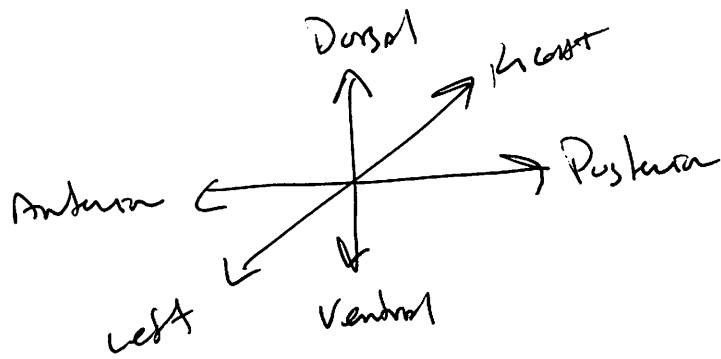


APOPTOSIS

→ programmed cell death
→ "blebbing" → forming tube
that get engulfed by scavenger cells.

- C. elegans.
- triggered by signal transduction pathway
- APOPTOTIC PROTEIN

⇒ the BDT Plan must be superimposed on the Differentiation Process



BOTH AXES

Positional Information controls PATTERN Formation

↓
cytoplasmic determinants
&
inductive signals

Homeotic Genes (Edward Lewis)

— control pattern formation in the late embryo, larva, and adult

Christiane Nüsslein-Volhard 1995 Nobel Prize

↳ identified 120 genes necessary for normal segmentation

MATERNAL EFFECT GENES (EGG POLARITY GENES)

↓
cytoplasmic determinants.

↳ mutations are embryonic lethals

Bicoid Gene — "two tailed"
— essential for setting up the anterior end of the fly.

Maternal mRNAs are crucial during development of many species

"EVO-DEVO"

16.2

(4)

CLONING

Totipotent (plants) - A mature cell that can "de-differentiate" and give rise to all the specialized cell types of an organism.

Nuclear transplantation - "Dolly"

Stem Cells - unspecialized cells that can reproduce themselves in both AND differentiate into specialized cells of one or more types

ES cells - embryonic stem cells
- from the blastula (blastocyst) stage

Adult Stem Cells - serve to replace non-reproducing specialized cells as needed

→ Pluripotent → capable of differentiating into many different cell types.

iPS cells - 2007
- induced pluripotent stem cells
reverted to stem cell stage by retroviruses
carrying cloned copies of master regulatory genes

!!
o.

16.3 Cancer

Proto-oncogene



oncogene

(promote excess cell growth)

- ① movement of DNA (translocation or transposon)
- ② amplification of proto-oncogene
- ③ point mutation in control element of proto-oncogene

- tumor-suppressor gene

- mutations that decrease their normal activities may lead to cancer.

→ stimulating growth through the absence of suppression

TS-gene

- ① repair damaged DNA
- ② control adhesion to other cells
- ③ produce proteins for cell signalling pathways.

Ras gene - proto-oncogene - 30% human cancer

- G protein

→ growth factor activates it

→ mutation can cause it to signal "growth" without growth factor.

P53 gene - tumor suppressor gene

- 50% human cancer.

- 53,000 amino acids protein product

↳ p53 protein is transcription factor that promotes synthesis of cell cycle inhibiting proteins.

- (6)
- p53 - "guardian angel of the genome"
 - ✓ many functions
 - miRNA's probably participate in cancer development.

Multi-step Model of Cancer Development

- ✓ more than one somatic mutation is usually needed to produce cancer

Hence - cancer increases with AGE

- colon cancer - 6 changes
- Ras + p53

oncogenes - dominant gene

T-S gene - recessive

→ both must be mutated

- the order matters

Pre-disposition to ~~selective~~ cancer because of inherited mutated genes

BRECA-1 - breast cancer gene

T-S gene

BRECA-2

VIRUSES

- can cause cancer.
- 15%