

Lecture VI. Making Connections

Bio 3411
Monday
September 14, 2009

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September 14, 2009

Lecture VI. Making Connections

2

Reading

NEUROSCIENCE: 4th ed, Chapter 23, pp
577-609

September 14, 2009

Lecture VI. Making Connections

3

Selected References:

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September 14, 2009

Lecture VI. Making Connections

4

What the last Lecture was about

- Programmed cell death (**apoptosis**) is a physiological mechanism distinct from necrotic cell death.
- **Apoptosis** occurs widely during normal development of the nervous system.
- Isolation of specific molecules involved in promoting growth and survival – "trophism," e.g., Nerve Growth Factor (**NGF**).
- What is the "death mechanism" that NGF (and other neurotrophins) inhibit?
- Broader implications: controlled cell death in neuroembryology vs uncontrolled cell growth of cancer.
- Gene homologies between organisms - humans and worms (nematodes)
- Molecular models for apoptosis
- How do trophic factors connect to this cell death pathway(s)?

September 14, 2009

Lecture VI. Making Connections

5



September 14, 2009

Lecture VI. Making Connections

6

What this Lecture is about

- General mechanisms for assembling neurons and groups of neurons
- Diffusion vs Contact
- Attraction vs Repulsion
- Examples of impacts of contact
- Examples of impacts of diffusion
- Specification by growth factors
- The chemoaffinity hypothesis

September 14, 2009 Lecture VI. Making Connections 7

Outline of Neurodevelopment

Fertilization
Embryonic morphogenesis
Induction of Neuroectoderm
Neurulation

Segmentation

Differentiation:

1. Formation and placement of neuroblasts
2. Axonal outgrowth
3. Growth cones, selective migration
4. Selective fasciculation
5. Target selection
6. Synaptogenesis
7. Etc... (cell shape, neurotransmitter, ionic channels, receptors)

Adult neuronal plasticity
(Activity-dependent?)

September 14, 2009 Lecture VI. Making Connections 8

Selective Adhesion Determines Specificity of Tissue and Cellular Associations

September 14, 2009 Lecture VI. Making Connections 9

Selective Aggregation of dissociated embryonic tissues (vertebrate and invertebrate) suggests ancient (surface) Adhesion Molecules

Epidermis + Mesoderm

1. Sponges (Wilson, 1907)
2. Amphibians (Townes and Holtfreter, 1955)
3. Chick (Moscona, 1952)

(Townes and Holtfreter, 1955)

September 14, 2009 Lecture VI. Making Connections 10

Experimental recreation of morphogenesis by mixing cells expressing low and high levels of one surface adhesion gene (N-cadherin)

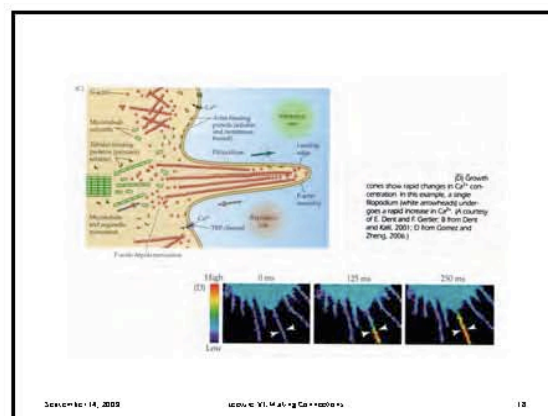
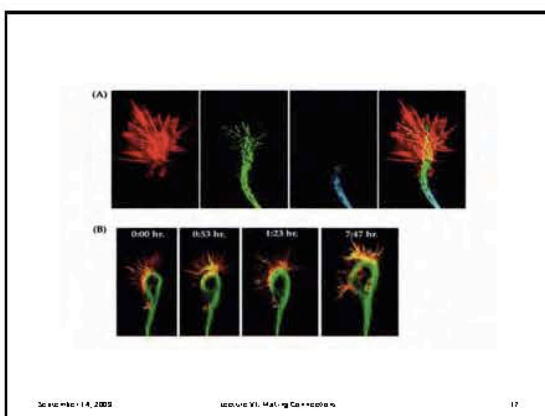
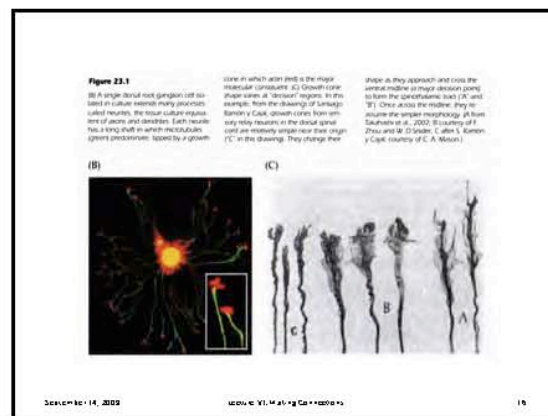
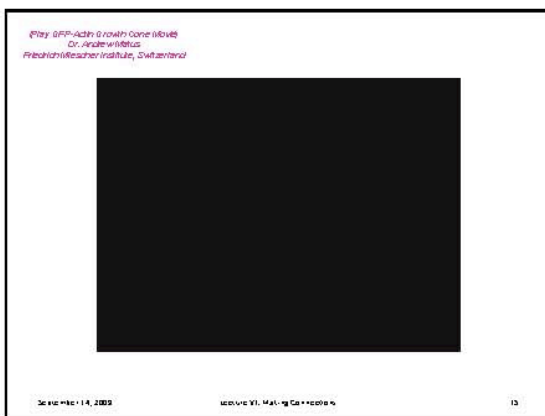
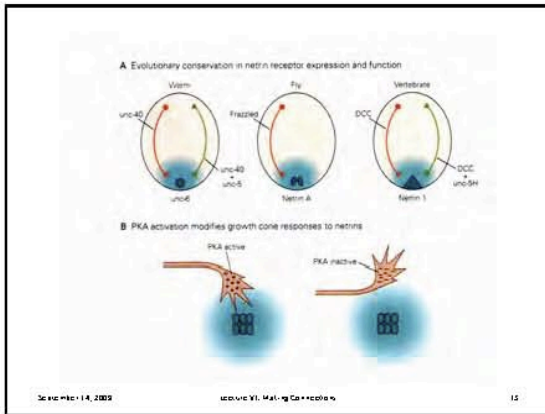
Green = high N-cadherin
Red = low N-cadherin

(Foty and Steinberg, 2004)

September 14, 2009 Lecture VI. Making Connections 11

Effect/ Proximity Distant Contact	Attraction Repulsion
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September 14, 2009 Lecture VI. Making Connections 12



What this Lecture was about

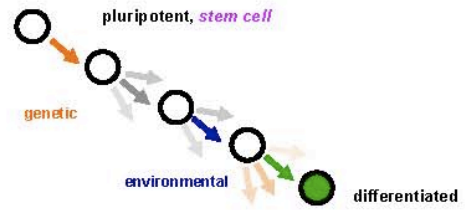
- Grouping neurons and processes
- Partner selection
- Some genetic foundations/correlates
- Systematic organization of connections
- Roles of contact and diffusion
- *Deja vu*

September 14, 2009

Lecture VI. Making Connections

21

Sequential Restrictions (Refinements) are the Bases for Development



September 14, 2009

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22



September 14, 2009

Lecture VI. Making Connections

23

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September 14, 2009

Lecture VI. Making Connections

24