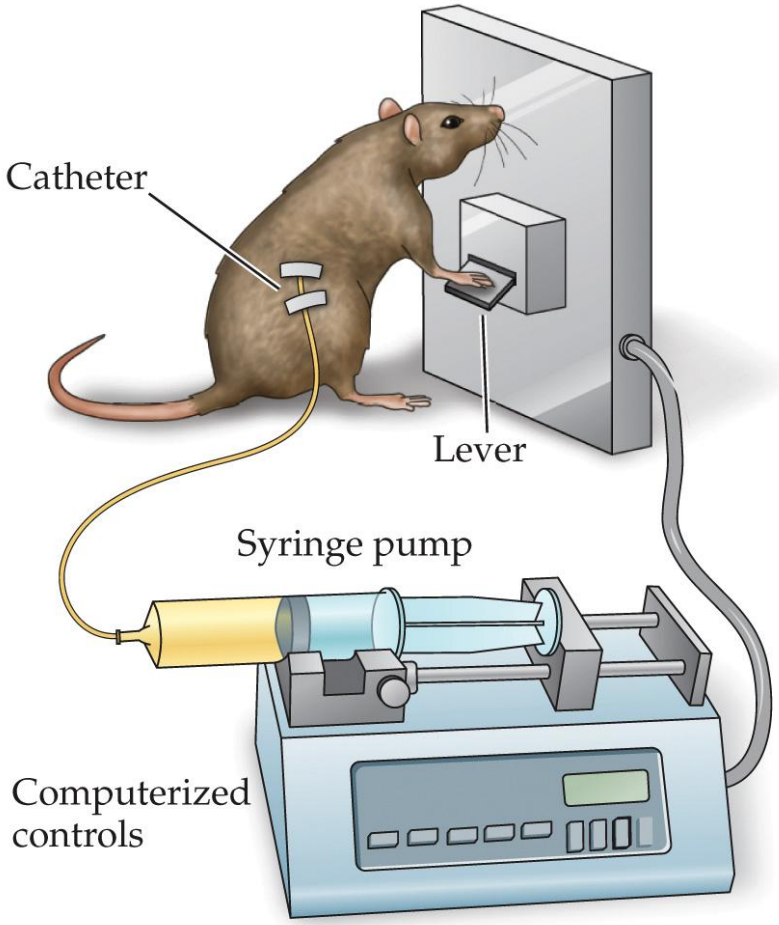
# Introduction to Neuroscience

## Lecture 13
Development of the Brain

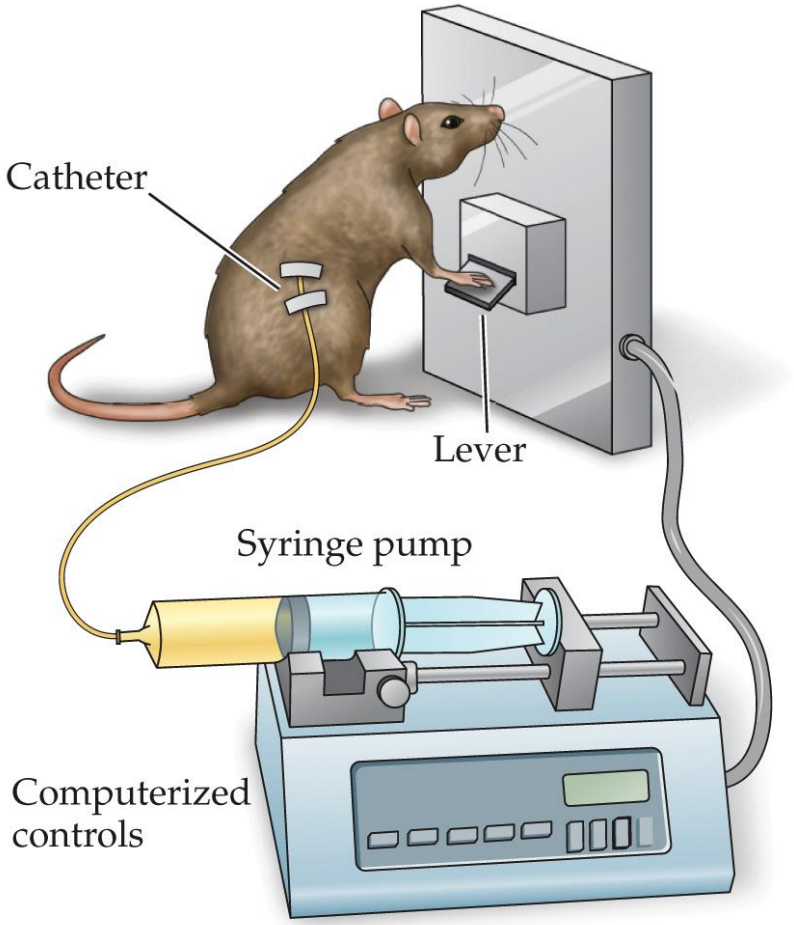
# Review




*THE MIND'S MACHINE 4e*, Figure 3.14
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What is the name of the experimental setup shown on the left? What is it used for?

# Review




*THE MIND'S MACHINE 4e*, Figure 3.14
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Drug self-administration

Used for measuring the rewarding properties of a drug

# Growth and Development of the Brian Are Orderly Processes

The Road Ahead:

- List the six stages of cellular processes needed for brain development.
- Describe the two phases of brain development characterized by the loss of structures.
- Identify the basic mechanism that directs each developing neuron to take on the appropriate structure and function.
- Discuss the significance of generating new neurons in adulthood.

# Growth and Development of the Brian Are Orderly Processes

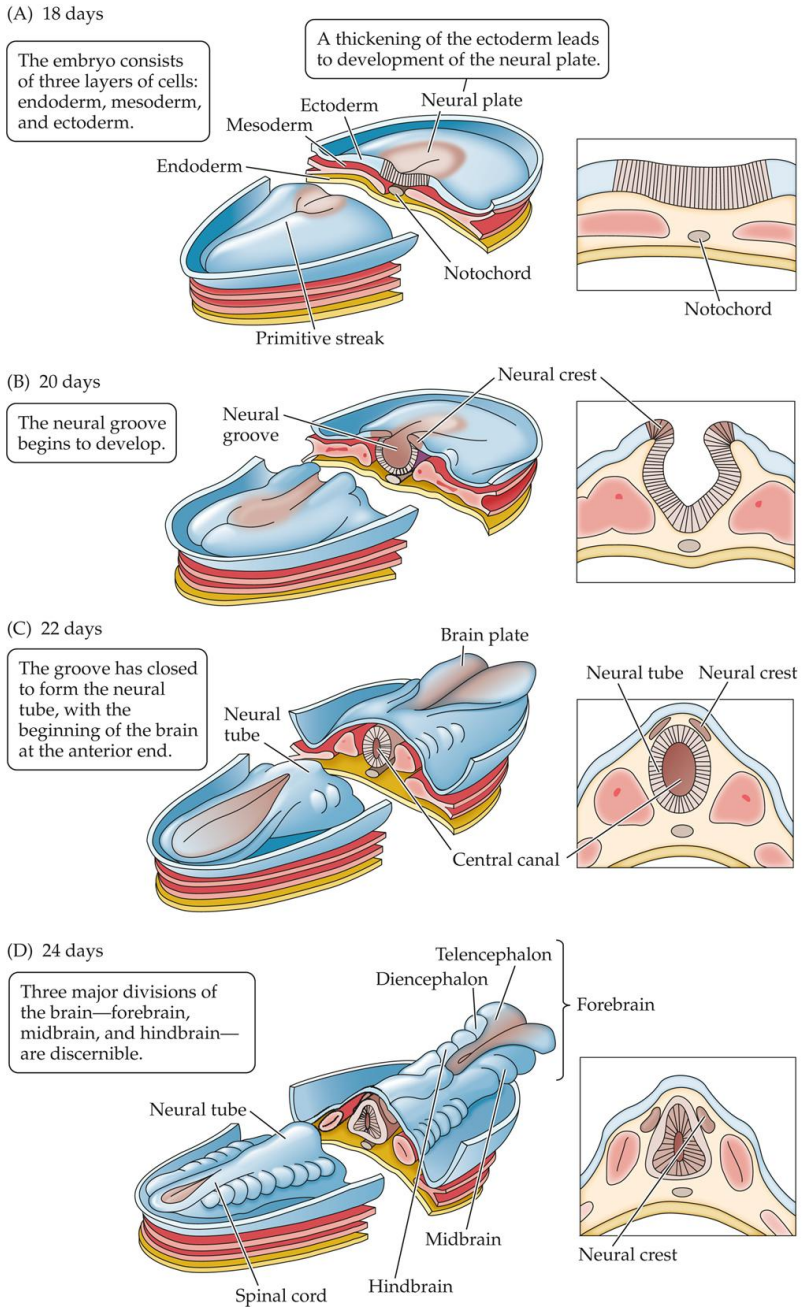
A human embryo develops three cell layers—endoderm, mesoderm, and ectoderm.

- **Ectoderm**—outer layer; becomes the nervous system

The crests of the neural groove join, forming the **neural tube**.

The anterior part of the neural tube has three subdivisions—the **forebrain**, the **midbrain**, and the **hindbrain**.

# Development of the Nervous System in the Human Embryo and Fetus



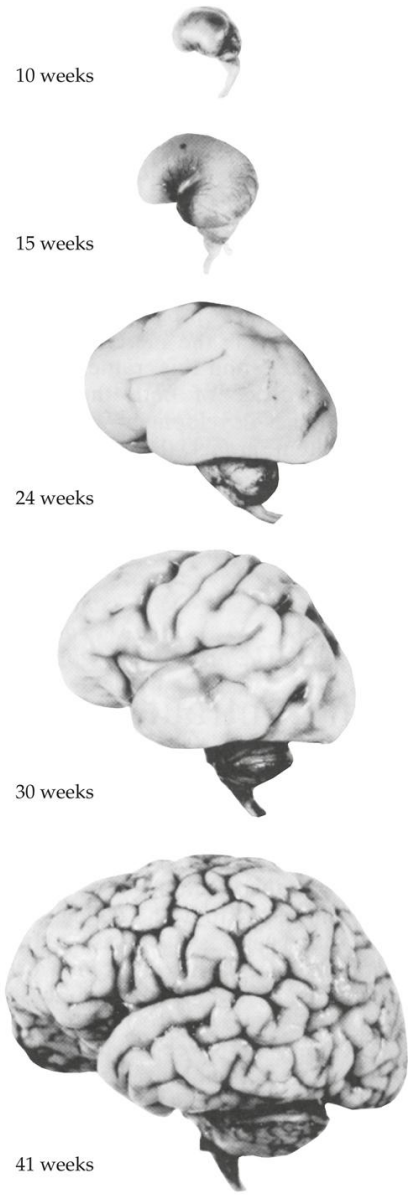



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# Development of the Nervous System in the Human Embryo and Fetus

(E)

In these views of the human brain (shown at one-third size) at several stages of fetal development, note the gradual emergence of gyri and sulci.



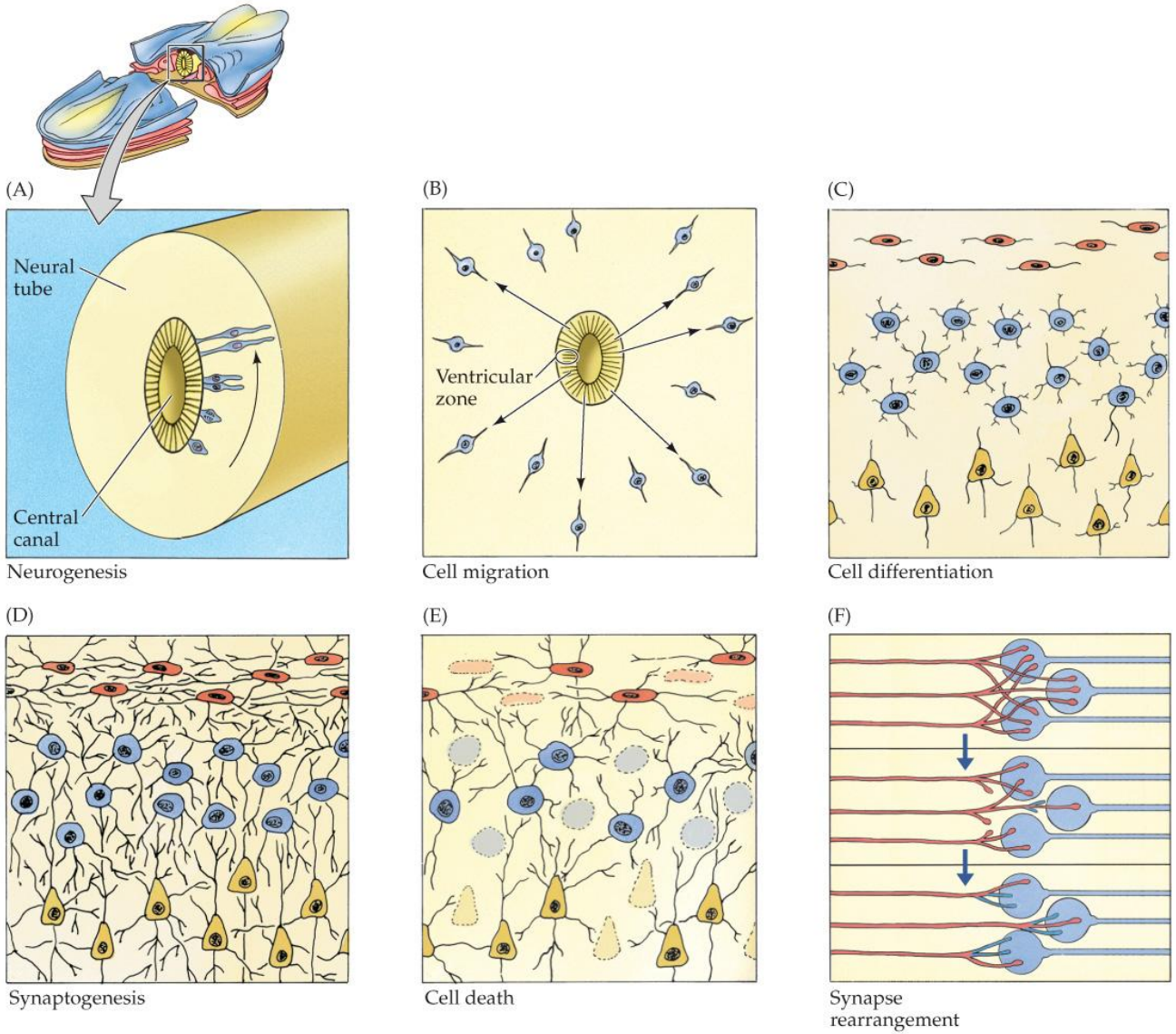

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# Development of the Nervous System Can Be Divided into Six Distinct Stages

Six stages of brain development:

1. **Neurogenesis**—mitosis produces neurons from non-neuronal cells, forming the **ventricular zone**.
2. **Cell migration**—cells move out of the ventricular zone toward their destination, where they **express** particular genes.
3. **Cell differentiation**—cells become distinctive types of neurons or glial cells through **cell-cell interactions**.
4. **Synaptogenesis**—establishment of synaptic connections
5. **Cell death**—selective death of many neurons
6. **Synapse rearrangement**—loss or development of synapses, fine-tuning

# Figure 4.3 The Six Stages of Neural Development




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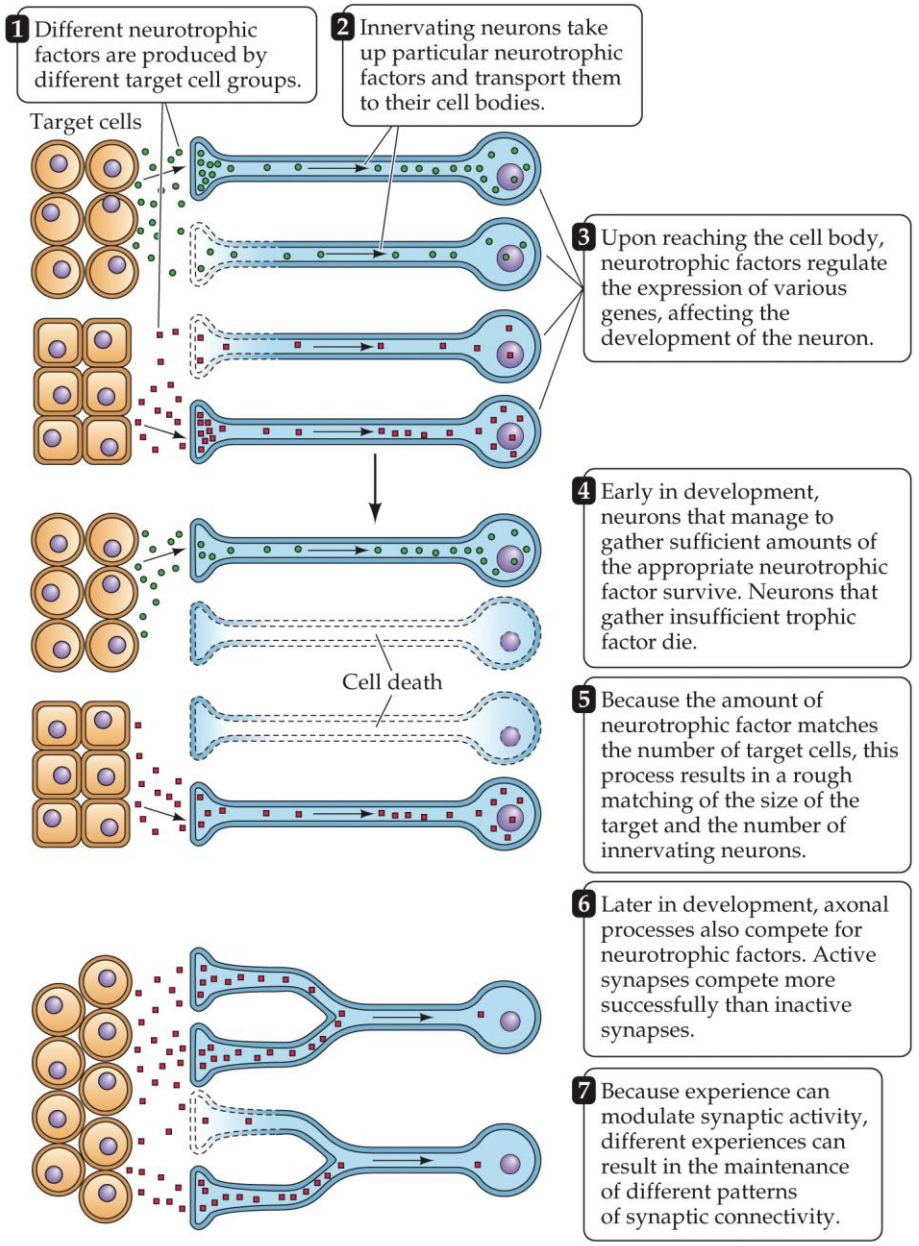
# In the Adult Brain, Newly Born Neurons Aid Learning

- **Adult neurogenesis** is the generation of new neurons in adulthood, especially in the dentate gyrus.
- Neurogenesis is enhanced by factors such as exercise, environmental enrichment and training.
- Neurogenesis enhance hippocampal-dependent learning (special memory, fear conditioning).
- Training (e.g. studying!) improves neurogenesis.
- Physical exercise boosts neurogenesis in rats – an effect that was blocked by stressors such as social isolation (Stranahan *et al.,* 2006).

# The Death of Many Neurons Is a Normal Part of Development

- **Cell death** (*apoptosis*) is an important part of brain development.
- The number of neurons that die during early development is large.
- Death genes are expressed only when a cell undergoes apoptosis.
- Neurons compete for synaptic connections and **neurotrophic factors**.
- Neurotrophic factors are target derived chemicals that act as if they feed neurons to help them survive.

# Figure 4.6 A Model for the Action of Neurotrophic Factors




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