I. How Do Genetic Factors Affect Behavior?

A. Nature vs. Nurture

- **Nature** = **biology**
- **Nurture** = **environment**

How much influence does each have on behavior?

The Wicked Identical Twins: Jim Lewis and Jim Springer

- As youngsters, each Jim had a dog named “Toy.”
- Each Jim had been married two times -- the first wives were both called “Linda” and the second wives were both called “Betty.”
- One Jim had named his son “James Allan” and the other Jim had named his son “James Alan.”
- Both Jims smoked Salem cigarettes and drank Miller Lite beer.
- Each twin had driven his light-blue Chevrolet to Pas Grille beach in Florida for family vacations.
- Both Jims had at one time held part-time posts as sheriffs.
- Both were fingernail biters and suffered from migraine headaches.
- Each Jim enjoyed leaving love notes to his wife throughout the house.

IV. How Do Genetic Factors Affect Behavior?

B. The Basics of Genetics

- Each human cell contains 23 pairs of **chromosomes**
  - Carry **genes**
  - About 20,000 in humans
- **Genotype**
- **Phenotype**

Chromosome Pairs
Some Genetic Traits
- Hair and eye color
- Baldness
- Color blindness
- Tongue curling
- "Hitch-hiker's thumb"
- Ring finger length
- Height
- Widow's peak

C. How Genes Affect Behavior
- Twin studies
  - Fraternal twins
    - Dizygotic (DZ) twins
    - 2 sperm/2 eggs
    - No more similar than regular siblings
    - Identical traits
    - Monozygotic (MZ) twins
    - 1 sperm/1 egg split
    - Identical genes
- Identical twins raised apart share genes, not environment
- Fraternal twins raised together share environment, not genes
- Most behaviors determined by interaction between genes and environment

Exremely Identical Twins: Jim Lewis and Jim Springer
- As youngsters, each Jim had a dog named "Toy."
- Each Jim had been married two times -- the first wives were both called "Linda" and the second wives were both called "Betty."
- One Jim had named his son "James Allan" and the other Jim had named his son "James Alan."
- Both Jims smoked Salem cigarettes and drank Miller Lite beer.
- Each twin had driven his light-blue Chevrolet to Pass A Grille beach in Florida for family vacations.
- Both Jims had at one time held part-time posts as sheriffs.
- Both were fingernail biters and suffered from migraine headaches.
- Each Jim enjoyed leaving love notes to his wife throughout the house.

I. How is the Nervous System Organized?
- A. Cellular Level
  - The Neuron
    - Single nerve cell = neuron
    - Building block of the nervous system
    - Bundle of neurons = nerve or tract
1. The Neuron
   - Structure of neurons:
     - Dendrites
     - Axon
     - Axon Terminals
   - Synapse:
     - Gap between axon terminal and dendrite

2. The Functioning of Neurons
   - Communication is electrochemical
     - Within neurons = electrical
     - Between neurons = chemical

3. Neurotransmitters
   - Serotonin:
     - Mood regulation; sleep; aggression; appetite
   - Dopamine:
     - Learning; attention; movement; seems related to the brain’s reward system

Nervous System
- Central Nervous System
- Peripheral Nervous System
  - Brain
  - Spinal Cord
2. Central Nervous System
   a. The Brain
      - Lower structures = more basic functions
      - Higher structures = more complex functions

   b. Spinal Cord
      - Relays information to and from brain
      - Controls spinal reflexes without input from brain
        • E.g., Knee-jerk reflex

1. Peripheral Nervous System
   a. Somatic nervous system
      - Under voluntary control
      - Responds to/acts on outside world

   b. Autonomic nervous system
      - Controls automatic processes
      - Two subdivisions

      i. Sympathetic N.S.
         • Activates fight-or-flight response

      ii. Parasympathetic N.S.
         • Active more often
         • Controls normal operations, calms body

Brain Facts
- The brain has about 100 billion neurons...
  • Counting them at 1 per second would take over 3,100 years
- By age 6 or 7, your brain is almost its adult size, and stops growing around age 18

- The brain consumes vastly more energy than any other part of the body...
  • It's only 2% of your weight, but...
  • It uses 15% of your heart's output and 20% of all the oxygen you breathe
Brain Facts

- Brain cells can and DO grow back
- Your brain weighs about 3 lbs
- The brain’s wrinkles give it more surface area...
  If you smoothed out the wrinkles, it would be about the size of a pillow case

- The brain does not feel pain
- The number of possible thought pathways that your brain can make is 1 followed by 6½ miles of normal type-written zeros
- That’s bigger than the number of atoms in the known universe

The Story of Phineas Gage

How a man’s unfortunate accident helped change our understanding of the brain

This shows the path the rod took as it passed through his skull

Gage’s “Death Mask” & Skull

15-year-old survives knife attack in London

On display at the Harvard Medical School Library
Comparison of Mammal Brains

RAT
RABBIT
CAT
SHEEP
DOLPHIN
HUMAN

2. Central Nervous System

Brain

Hindbrain
Midbrain
Forebrain

a. The Hindbrain
- Medulla
  - Basic survival functions (breathing, heartbeat)

b. The Midbrain
- Reticular formation
  - Arousal
- Pons
  - Links hindbrain to higher parts
- Cerebellum
  - Balance, coordination

<table>
<thead>
<tr>
<th>a. The Hindbrain</th>
<th>b. The Midbrain</th>
<th>c. The Forebrain</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Reticular formation</td>
<td>i. Midbrain</td>
<td>a) Thalamus</td>
</tr>
<tr>
<td>- Arousal</td>
<td>- Receive signals from spinal cord and other parts of brain</td>
<td>- &quot;relay station&quot; for information</td>
</tr>
<tr>
<td>c) Pons</td>
<td>- i. Midbrain</td>
<td>b) Hypothalamus</td>
</tr>
<tr>
<td>- Links hindbrain to higher parts</td>
<td>- ii. Midbrain</td>
<td>- Eating, drinking, sex drive</td>
</tr>
<tr>
<td>d) Cerebellum</td>
<td>- Receive signals from spinal cord and other parts of brain</td>
<td></td>
</tr>
<tr>
<td>- Balance, coordination</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In each picture, the rat on the right has had its ventromedial hypothalamus damaged.

c. The Forebrain
The Limbic System

Amygdala
- Emotions, learning

Hippocampus
- Memory, learning

a) Amygdala
b) Hippocampus

Cerebrum
- Largest structure in human brain
- Two hemispheres
- Connected by corpus callosum
- Covered by cortex

iii. The Forebrain
iii. The Forebrain
• Four lobes

- Frontal Lobe
- Parietal Lobe
- Occipital Lobe
- Temporal Lobe

Broca’s Area
Speech production

Wernicke’s Area
Understanding written and spoken language

The Sensorimotor Strip
Motor Area
Sensory Area

II. How Does the Brain Function?
B. Brain Specialization
1. Splitting the Brain
   • Hemispheres are not identical
   • Left hemisphere more involved in language
   • Right more with spatial abilities

1. Splitting the Brain
   Image in left visual field appears in right (non-verbal) hemisphere when looking straight ahead

1. Splitting the Brain
   OMG! It’s that singer who Mr. Doyle has a tattoo of!