

EVOLUTIONS, GENES, and BEHAVIOR

BIOLOGICAL BASIS OF BEHAVIOR

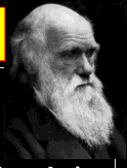
- All biological organisms have evolved over millions of years,
- Also, environmental factors have played an important role in shaping the organization and function of their nervous system.
- The evolutionary change = *Natural Selection* (Charles Darwin) = important role in shaping both *behavior* and *brain*.
- **GENE**
- **EVOLUTION**

Darwin's Theory of Evolution

- Modern biology began in 1859 with the publication of Darwin's "*On The Origin of The Species*" describing the *Theory of Evolution*.
- Species *evolve* (undergo gradual orderly change) from preexisting species.
- Darwin was NOT the first to propose this idea, but he was the first to *provide strong evidence* to support his idea



Darwin's Theory of Evolution



- Evolution occurs through “**natural selection**”
- **Natural selection** = mechanism by which evolution takes place
- **Fitness** = the ability of an organism to survive and contributes its genes to the next generation.
 - An organism with high rates of survival and reproduction will **pass on its genes** to the next generation

Evolution of Behavior

- **Proximate causes of behavior (HOW)**
 - such as the firing of special motor neurons to contract the muscles.
 - How a behavior is generated. Nervous system, hormones, brain function etc.
- **Ultimate causes (WHY)**
 - behavior in its evolutionary context.
 - Why we need this behavior.
- **Sexual selection**
 - aspects of **natural selection** that yields traits that promote reproductive success

Evolution of Behavior

- Early studies of evolution focused on **structure**
- **Behavior** also plays an important role in determining an organism's fitness
- The contribution of some behaviors (e.g. eating, sexual beh, predatory beh) are obvious. Others may be less obvious but very important
- One example is **Social Dominance**

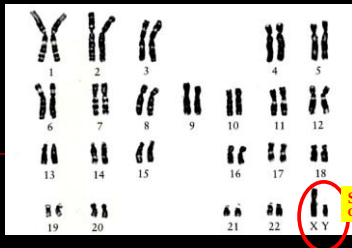
SOCIAL DOMINANCE

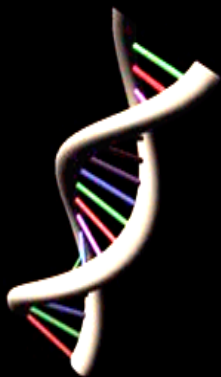
- Males establish “**hierarchy of social dominance**” by combative encounters with other males
- Social dominance influences evolution because **dominant males (or females) are able to copulate more**
- *McCann* (1981) found that the highest ranking bull accounted for 37% of copulation, the 2nd rank was for 19%,.... the lowest ranking was for only 1%
- An organism with high rates of survival and reproduction will **pass on its genes** to the next generation



Chromosomes and Genes

- **Chromosomes**
 - structure in the nucleus of each cell in the body. Most body cells contain **46 chromosomes**: 23 from father's sperm, 23 from mother's ovum
 - Each **chromosome** is a DNA molecule

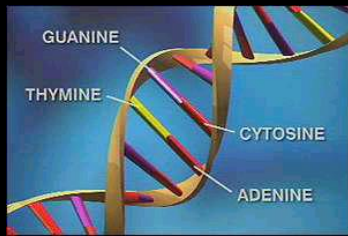




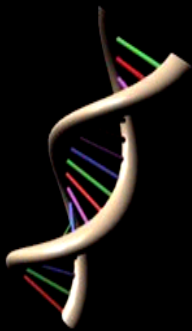
DNA

DNA (De-oxy-ribo-Nucleic Acid).

The chemical that all life uses for long-term storage of genetic information. Your **genes** are made of DNA. A **chromosome** contains one enormously long DNA molecule.



A DNA molecule is often diagrammed as a **spiral ladder**. The cross-arms are made of the **nucleotide bases** Adenine, Cytosine, Guanine, and Thymine (A,C,G,and T) attached to a chain of **phosphate** and **deoxyribose**. Specifically, there are four possible cross-arms: AT, TA, GC and CG.



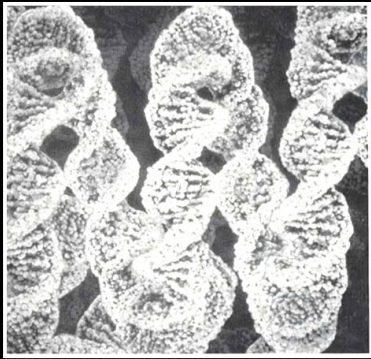
James Watson and Francis Crick
1953, Cambridge, UK

GENE

- Each **chromosome** is a DNA molecule
- **Gene** is on chromosome
- Each **gene** on a chromosome is either a whole molecule of DNA or a part of one
- DNA = Deoxyribonucleic Acid



A scanning electron microscope image of DNA molecules

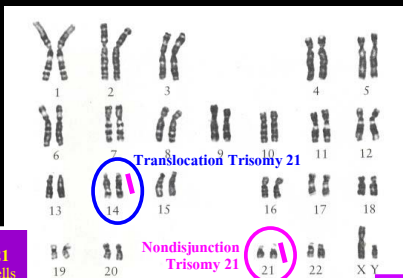


A photomicrograph of deoxyribonucleic acid (DNA).

TABLE 4-2 Risk of Giving Birth to a Down Syndrome Infant by Maternal Age

MATERNAL AGE	FREQUENCY OF DOWN SYNDROME INFANTS AMONG BIRTHS
30	1/885
31	1/826
32	1/725
33	1/592
34	1/465
35	1/365
36	1/287
37	1/225
38	1/176
39	1/139
40	1/109
41	1/85
42	1/67
43	1/53
44	1/41
45	1/32
46	1/25
47	1/20
48	1/16
49	1/12





Mosaic Trisomy 21
= Not all cells have extra chromosomes

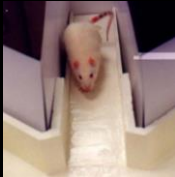
Chromosome abnormality = behavior problem



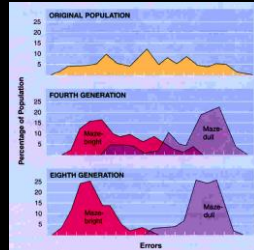
Genetic Studies and Behavior

• Selective breeding

- animals that are high or low in a certain behavior or physical trait are mated with each other



- Tryon raised maze-bright and maze-dull rats



Genetic Studies and Behavior

• Twin studies

- Study a group of monozygotic, dizygotic twins
- **Behavior genetics**
- Combines the methods of **genetics** and **psychology** to study the inheritance of behavioral characteristics
- measuring a behavioral attribute of a group of subjects (e.g., IQ) and ask what proportion of the variation among the subject resulted from genetic differences as opposed to environmental differences
- How many part of that behavior (e.g., IQ) is influenced by **genetic** / how many part is influenced by **environment**?

The Minnesota Study of Twins Reared Apart

Participants:

1. 59 pairs of identical twins and 47 pairs of fraternal twins who had been **reared apart**
2. Many pairs of identical and fraternal twins **reared together**

Behavior Measures:

- IQ
- Personality traits



- Heritability Estimate of IQ = 0.7
- The more **genes** you share, the high probability you might have similar IQ level.



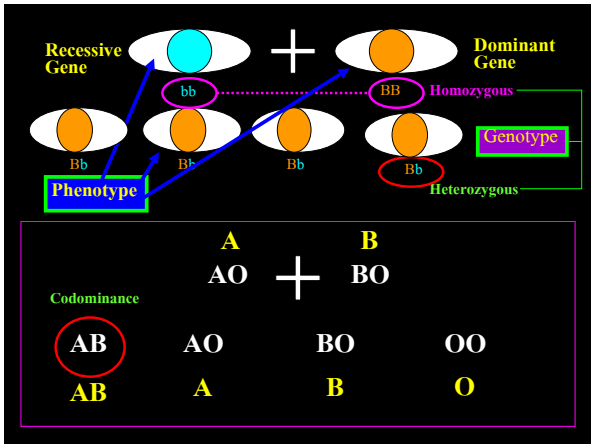
Genetic Studies and Behavior

- **Molecular genetics**
 - influence of specific genes on personality, and other specific behavioral traits
- **Environmental influences on gene action**
 - role of environment and interaction in manifestation of a behavior or particular disorder
 - Ex. Schizophrenia is hereditary (gene)
 - The chance to develop Schizophrenia depends on environmental factors
 - Genes may predispose a person to Schizophrenia, but the environment in which he or she grows up shapes the actual outcome (**Reaction range**)

Genetic Principles

- **Dominant - Recessive Gene**
- **Codominance**
- **Polygenic Inheritance**
- **Genotype** - Actual genetic material
- **Phenotype** - Expression of genotype





EVOLUTIONS, GENES, and BEHAVIOR

- From an **evolution** and functional point of view, any **behavior** that is **adaptive** (needed, important for survival of the species) will pass to the next generation.
- It confers **reproductive success**.
- Reproductive success promotes the perpetuation of **genes** that control that behavior

BIRTHDAY 'UGS
