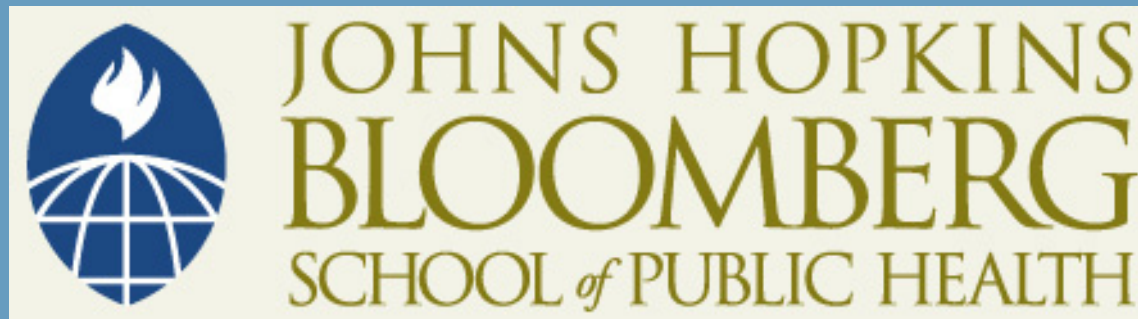


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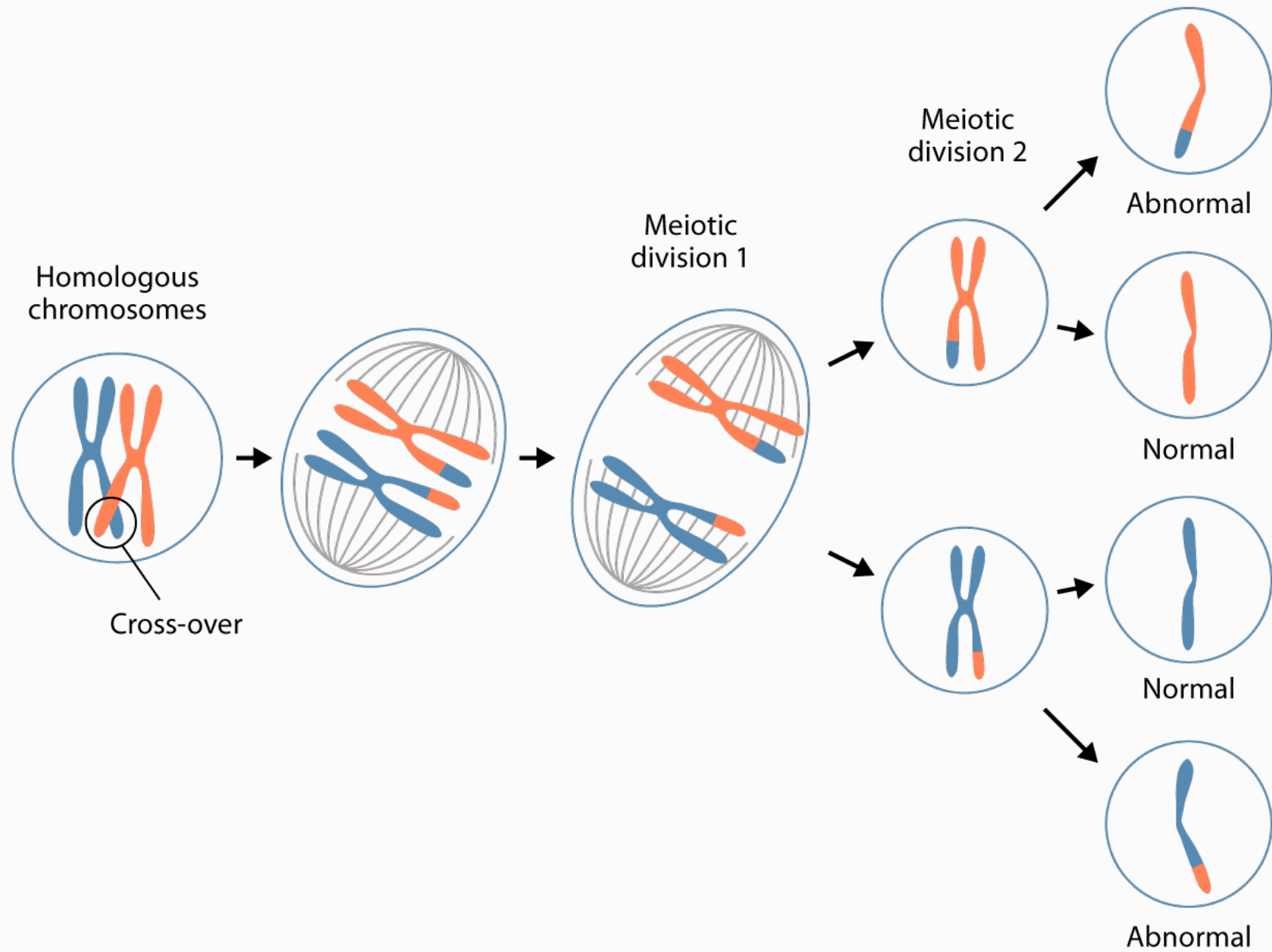


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BLOOMBERG
SCHOOL *of* PUBLIC HEALTH

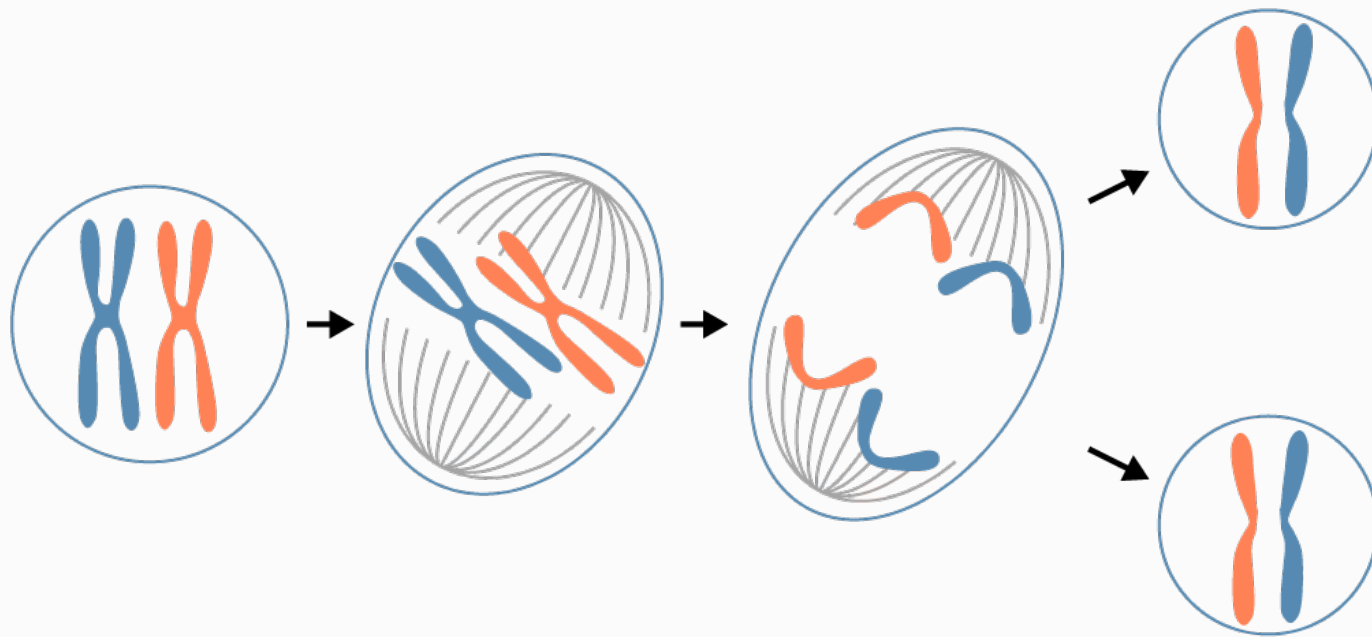
Section C

Genetics and Epigenetics

Meiosis

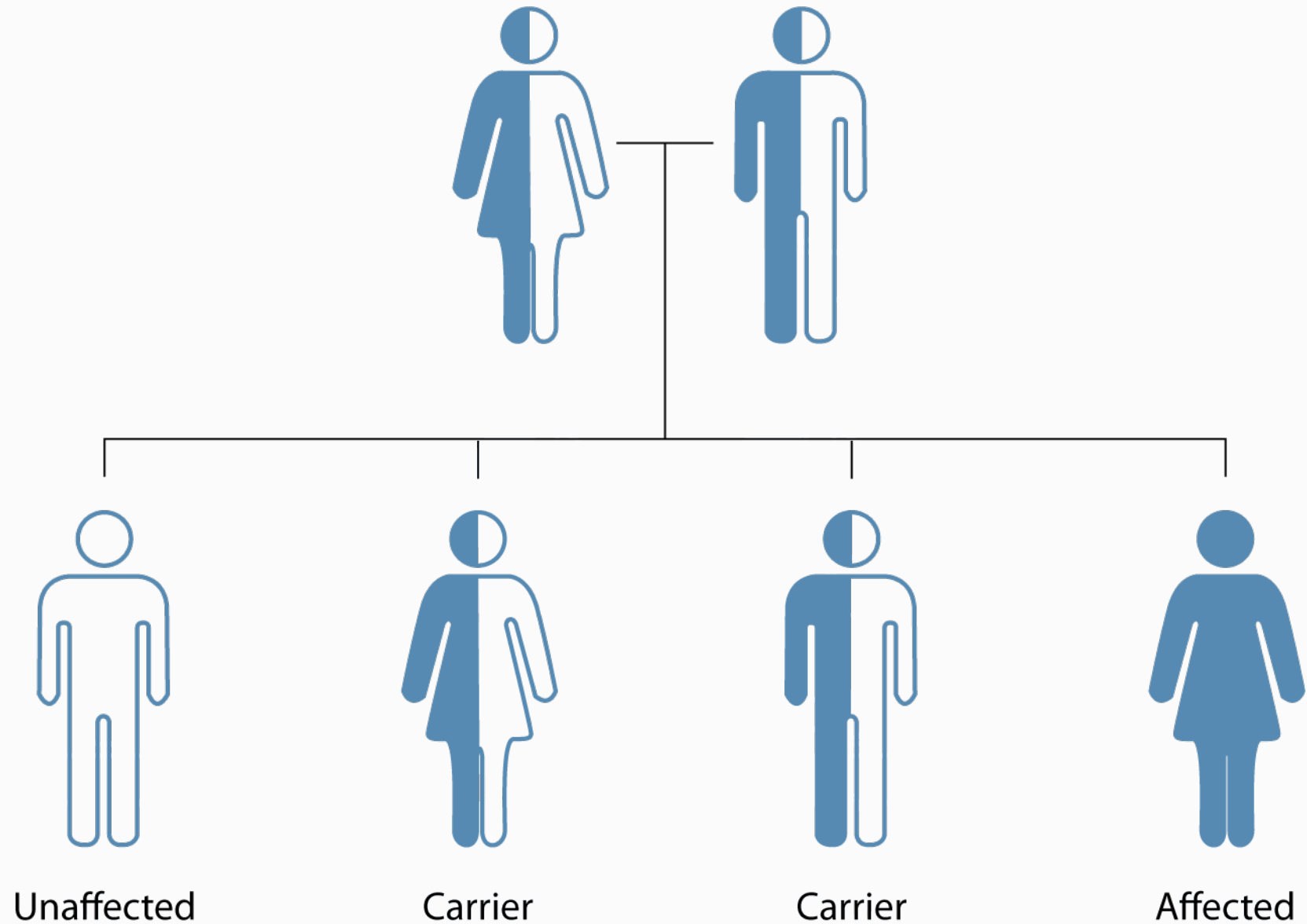


Mitosis

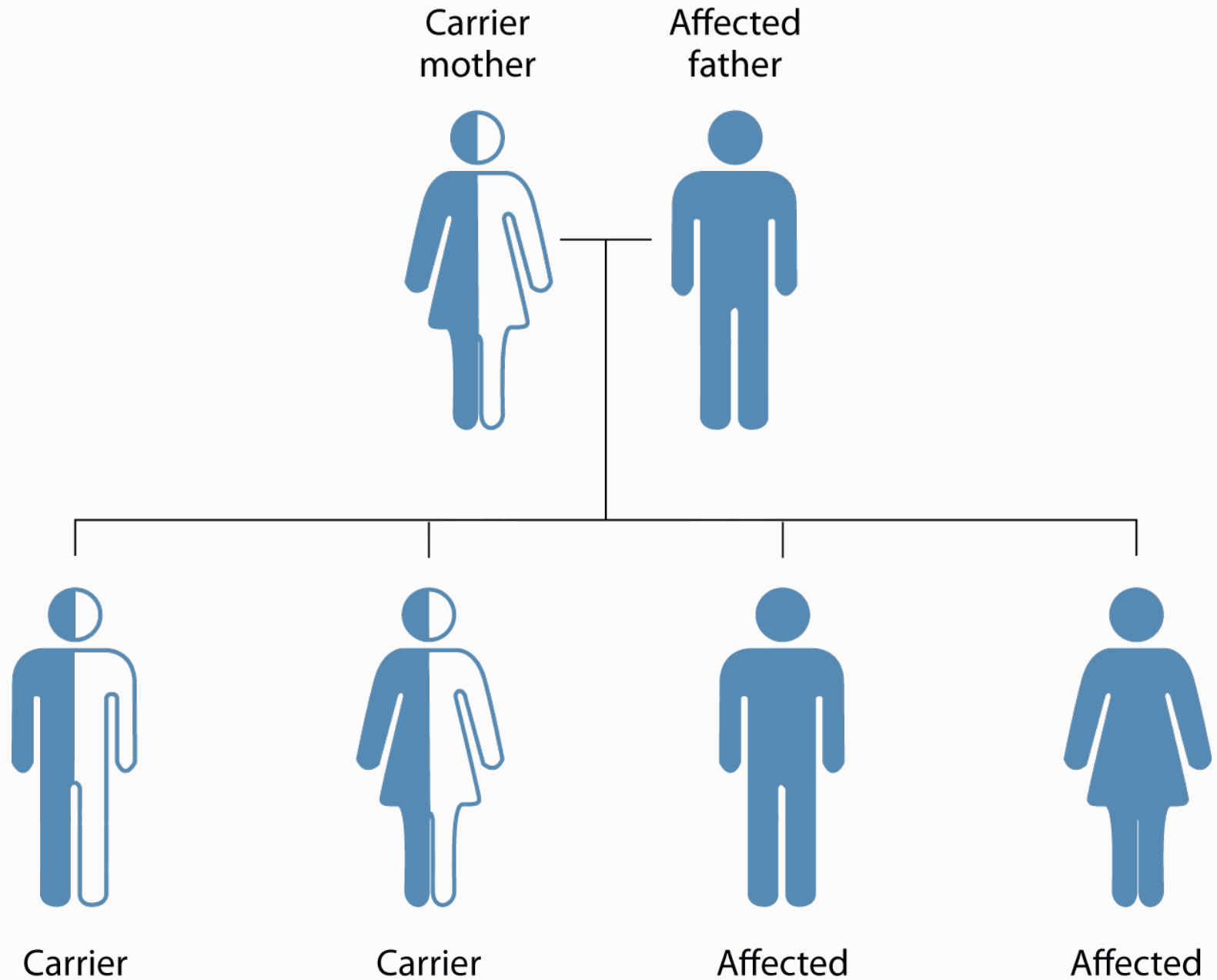


Cystic Fibrosis

Carrier Parents

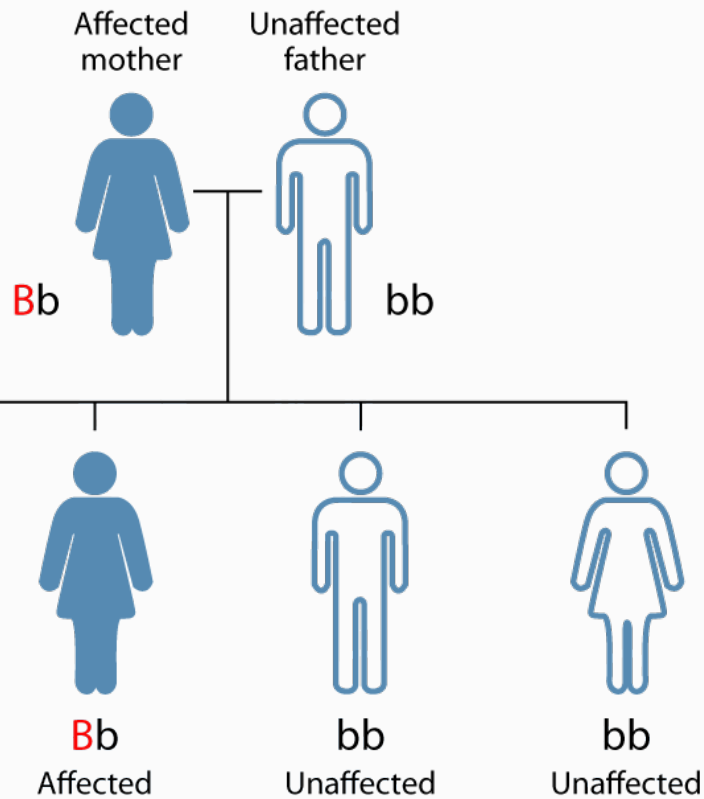


Sickle Cell Anemia

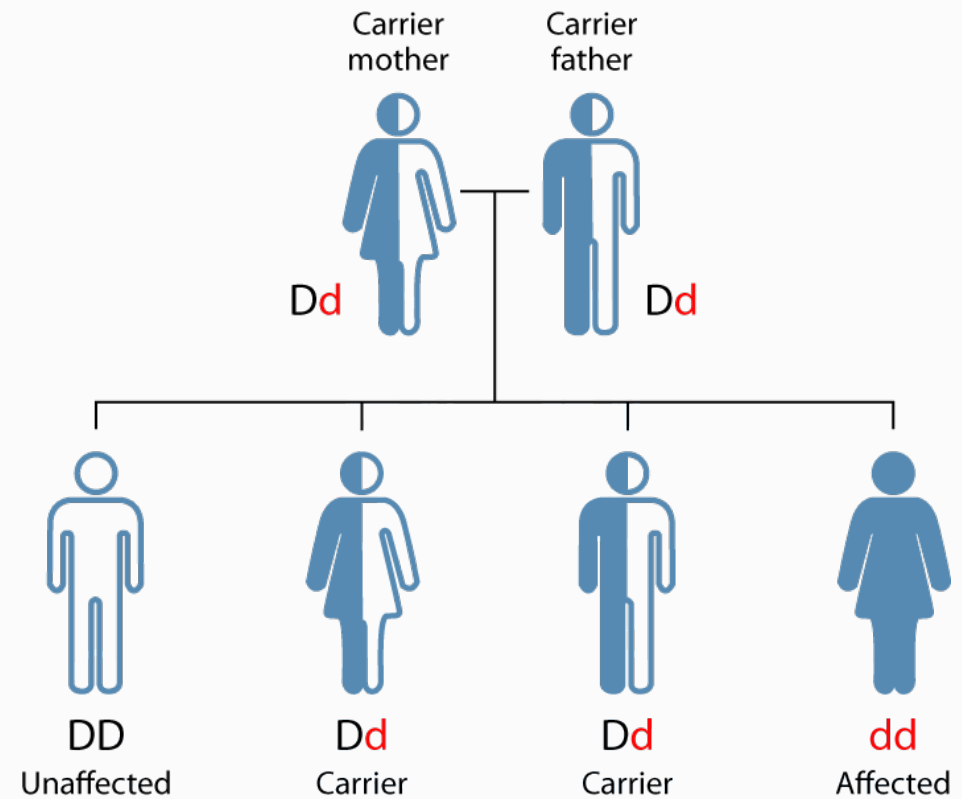


Dominant and Recessive Inheritance

Dominant Inheritance



Recessive Inheritance



Genetic Mutations

- Genetic mutations are permanent, transmissible changes to genetic material (DNA) of a cell
- Mutations can be caused by copying errors when the DNA divides to form two cells through meiosis: DNA gene sequence is transcribed into RNA which is translated into a protein sequence

Inheritance and Epigenetics

- Every cell has the same genetic information
- What differentiates tissues, organs, etc., is whether certain gene sequences are turned on (or expressed)
- But what influences genetic expression?

Epigenetics

- **Genetics** describes inheritance of information based on DNA sequence
- **Epigenetics** describes the inheritance of information on the basis of gene expression
- Epigenetic inheritance is not encoded in the protein sequence of the gene

Mechanisms of Epigenetics

- Methylation of DNA
- Modification of histones
- Binding of transcription factors of chromatin
- Timing of DNA replication

Epigenetics

- Junk DNA results when viral remnants insert themselves randomly into genes
- Epigenetics turns off or “silences” the replications of junk DNA

Epigenetics

- Epigenetics is the missing link between environment and the development of diseases
- Genetics explains only a small fraction of human disease at any age

Epigenetics

- Imprint genes do not depend on Mendelian patterns of inheritance where both parental gene copies are equally likely to contribute to the outcome
- Imprint genes depend on only female or male genes

Imprint Genes and Fetal Development

- The *in utero* battle of the sexes
 - Paternally expressed genes favor cellular proliferation, increased growth of placenta, and increases the rate of nutrient transfer from mother to fetus
 - Maternally expressed genes tend to do the opposite (they favor nutrient retention by the mother)

Understanding of Epigenetics and the Life Course

- How does our understanding of epigenetics contribute to our understanding of health and illness across the life course?
 - Pembrey et al. showed a relationship between paternal smoking and BMI in 9-year-old sons, but not daughters
 - Paternal grandfather's food supply in mid-childhood was linked to grandson (but not granddaughter) mortality risk

Nutrition, Epigenetics, and Fetal Health

- Nutrition can alter gene expression without altering gene structure—the case of obese yellow mice
- The association of the Dutch famine on schizophrenia among adult off-spring of women who were food deprived during their first trimester
- Malnutrition among pregnant women in the south during the Civil War and the Great Depression with high incidence of stroke in subsequent future generations

The Biologic Basis of Nurturance

- Anaclytic depression
- Licking, methylation, and stress response among adult rats

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- Anaclytic depression
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