Genetic Disorders & Diseases

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- Genetic diseases are disorders caused by abnormalities in an individual's genome
- They can be inherited from parents or arise spontaneously due to new genetic mutations
- Genetic diseases can affect a wide range of bodily functions and systems

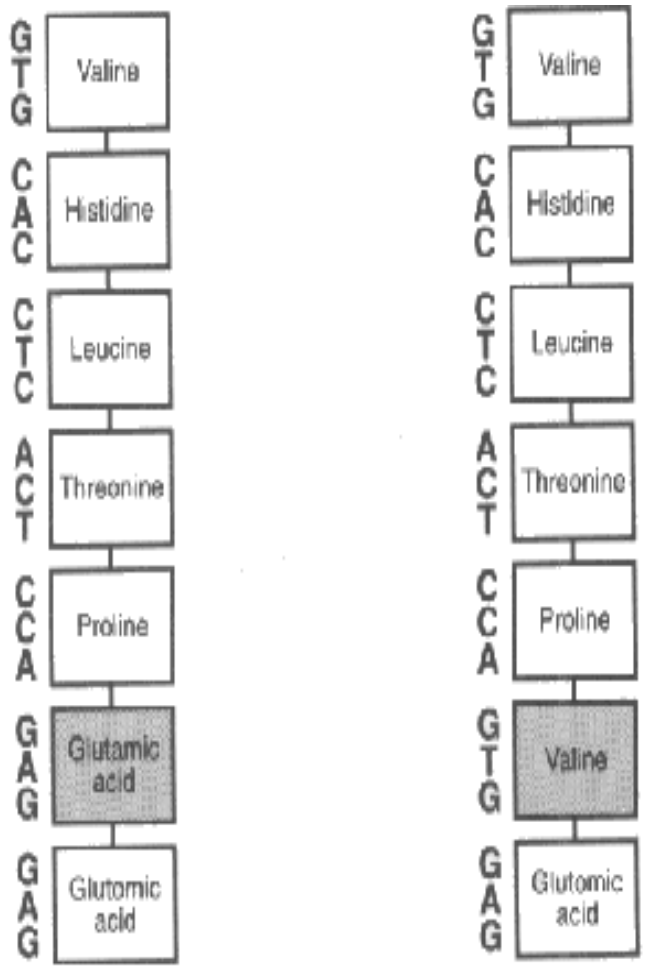
- Types of Genetic Diseases
- Monogenic diseases - caused by a mutation in a single gene
- Examples: Cystic fibrosis, Huntington's disease, sickle cell anemia
- Polygenic diseases - caused by mutations in multiple genes
- Examples: Diabetes, cancer, heart disease
- Mitochondrial diseases - caused by mutations in mitochondrial DNA
- Examples: Leber's hereditary optic neuropathy, Kearns-Sayre syndrome

- **Causes of Genetic Diseases**
- Gene mutations
- Point mutations, deletions, insertions, repeats
- Chromosomal abnormalities
- Down syndrome, Turner syndrome, Klinefelter syndrome

Genetic Disorders

- Genetic Disorders can also be caused by recessive defective alleles:
  - Each parent carries 1 recessive allele. Offspring may inherit the defective allele from both parents and get the disease.
    - Sickle cell
    - Phenylketonuria
    - Tay-Sachs
    - Cystic Fibrosis
    - Huntington's Disease

Sickle Cell


GTG
Valine
CAC
Histidine
CTC
Leucine
ACT
Threonine
CCA
Proline
GAG
Glutamic acid
GAG
Glutamic acid
GTG
Valine
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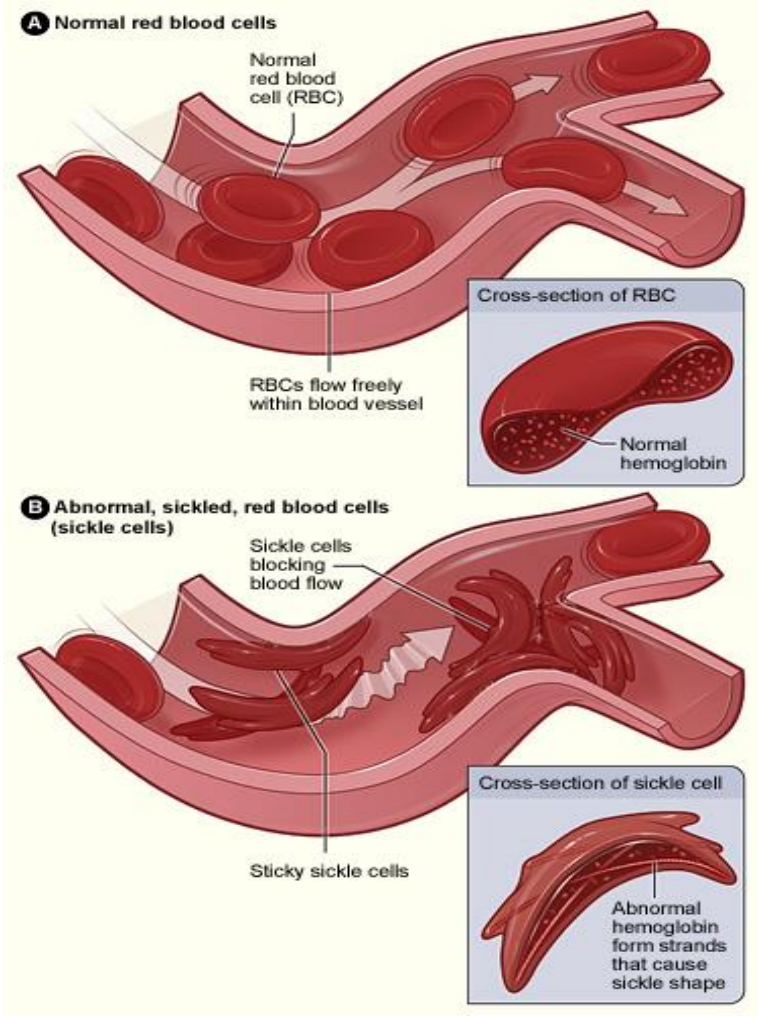
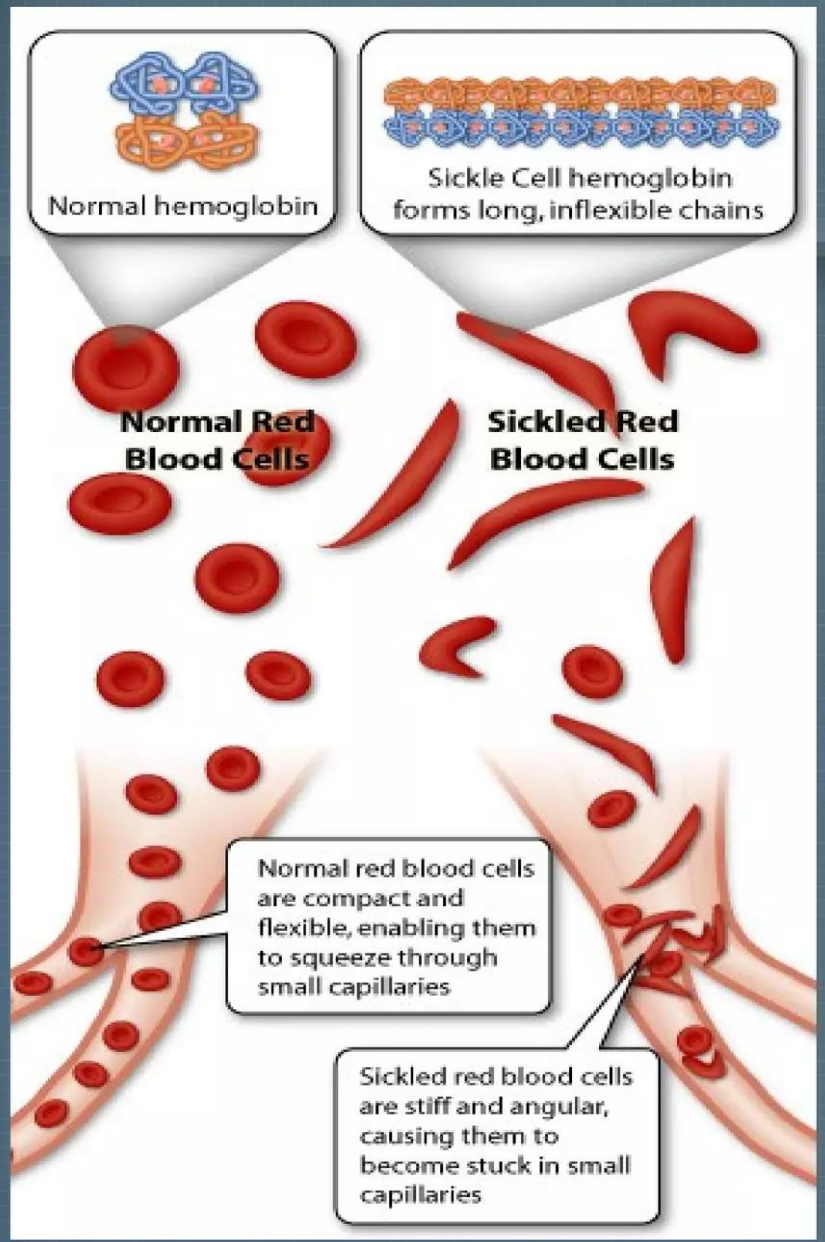
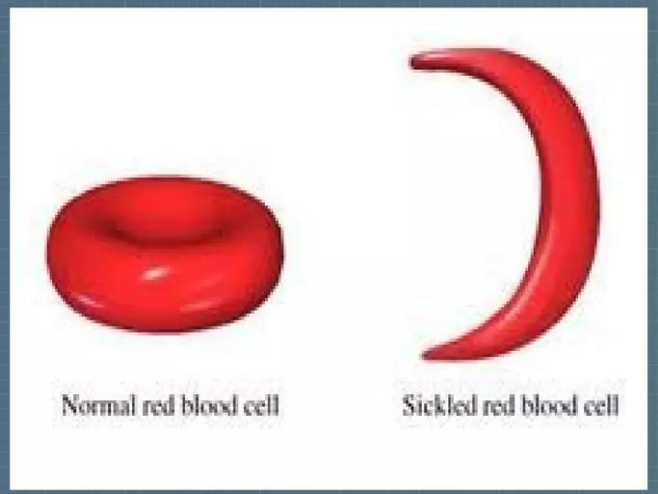
Proline
GTG
Valine
GAG
Glutamic acid


A Normal red blood cells
Normal red blood cell (RBC)
RBCs flow freely within blood vessel
Cross-section of RBC
Normal hemoglobin
B Abnormal, sickled, red blood cells (sickle cells)
Sickle cells blocking blood flow
Sticky sickle cells
Cross-section of sickle cell
Abnormal hemoglobin form strands that cause sickle shape


Normal hemoglobin
Sickle Cell hemoglobin forms long, inflexible chains
Normal Red Blood Cells
Sickled Red Blood Cells
Normal red blood cells are compact and flexible, enabling them to squeeze through small capillaries
Sickled red blood cells are stiff and angular, causing them to become stuck in small capillaries


Hemoglobin gene
Chromosome 11


Normal red blood cell
Sickled red blood cell

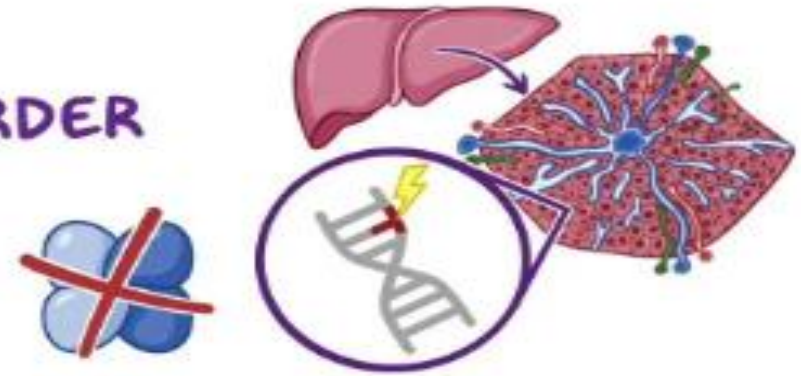
Phenylketonuria - PKU

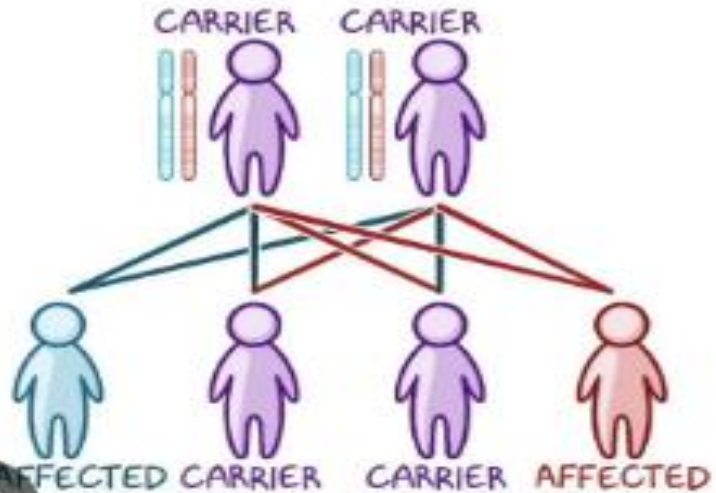
- Most children are screened at birth for PKU
- Can lead to mental retardation
- Smaller than normal head
- Epilepsy

Deficiency in the enzyme phenylalanine hydroxylase (PAH). This enzyme is necessary to metabolize the amino acid phenylalanine to the amino acid tyrosine

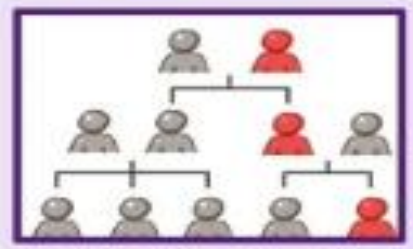
PKU

- AUTOSOMAL RECESSIVE GENETIC DISORDER
  - ~ MUTATION in GENE that codes for HEPATIC ENZYME PHENYLALANINE HYDROXYLASE
    - ↳ TWO COPIES of MUTATED GENE





PKU is MORE COMMON in:

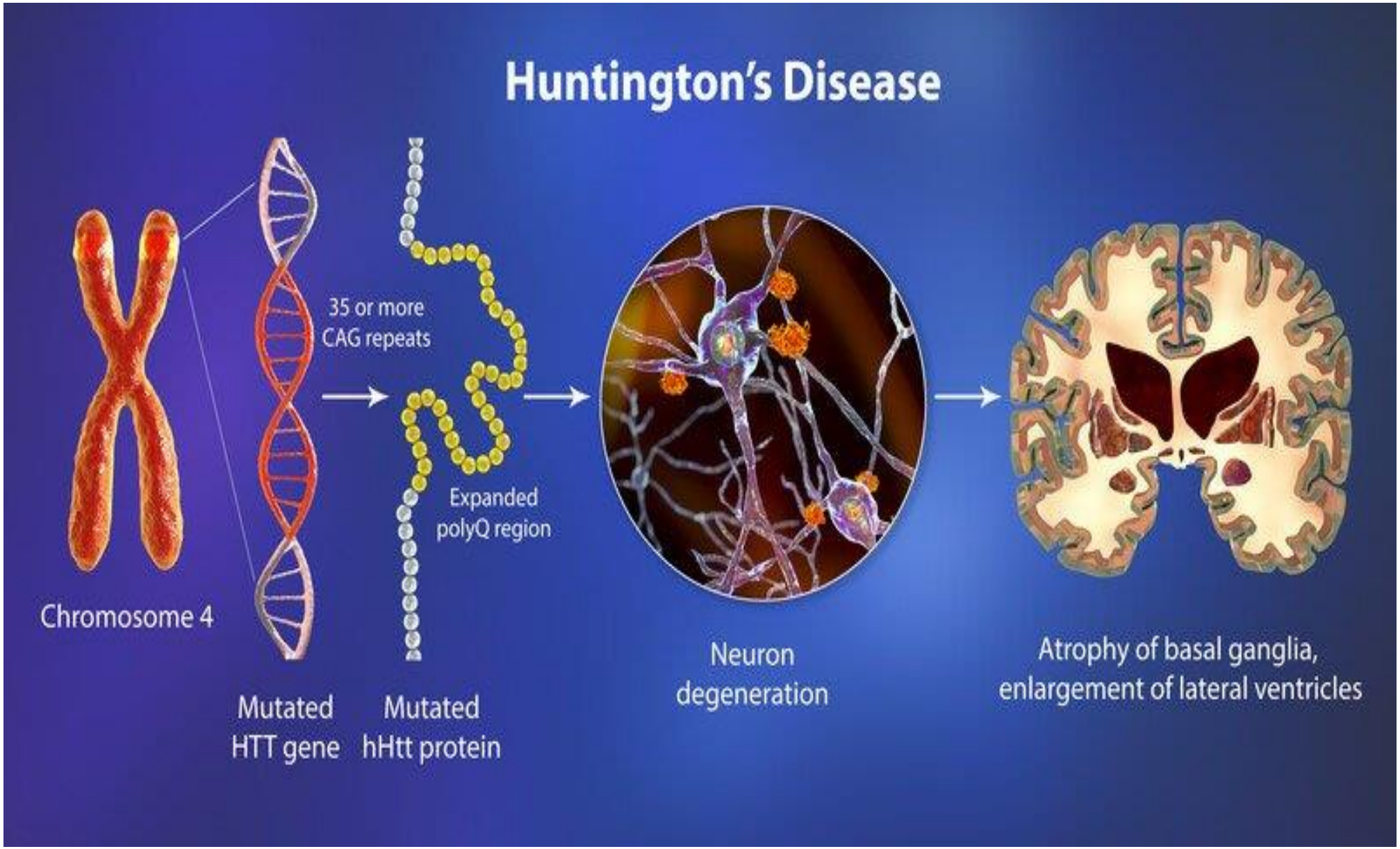


CLIENTS w/ FAMILY HISTORY

CLIENTS who COME from SAME REGION

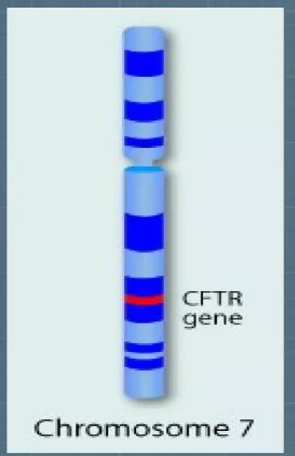
- **Huntington's Disease** – dominant disease, you need to inherit only 1 copy of the disease to have it. Abnormal protein is produced, and you start to kill brain tissue occurs around middle age, mood swings, paralysis, loss of memory, uncontrolled movements and eventually death
  - 1 in 20,000 in western hemisphere, 1 in 1 million in Asia

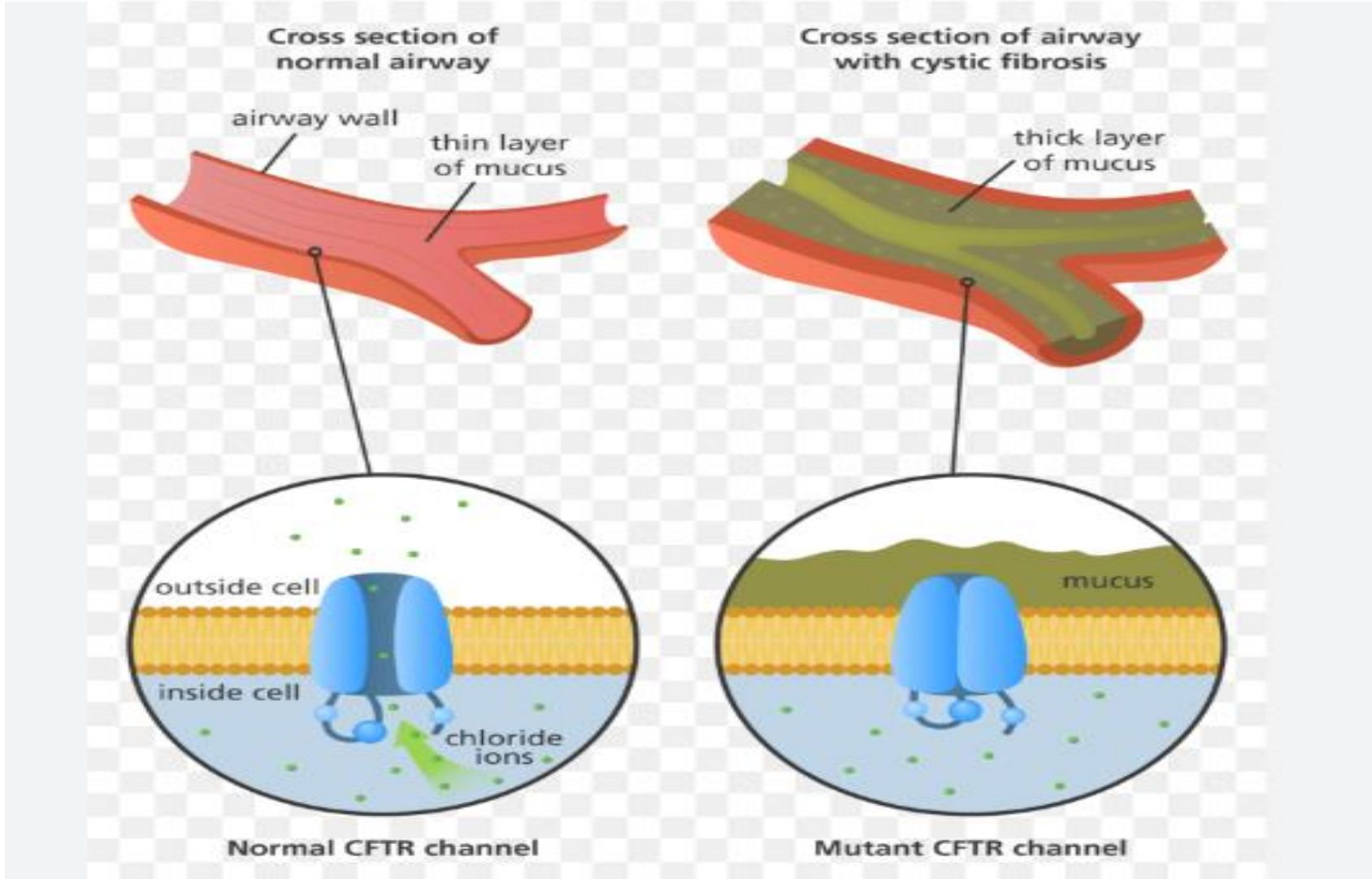
- **Cystic Fibrosis** – recessive disorder, a genetic mutation stops the production on a protein of cells in the lung, pancreas or other organ
  - Affects about 1 on 2500 births in the US

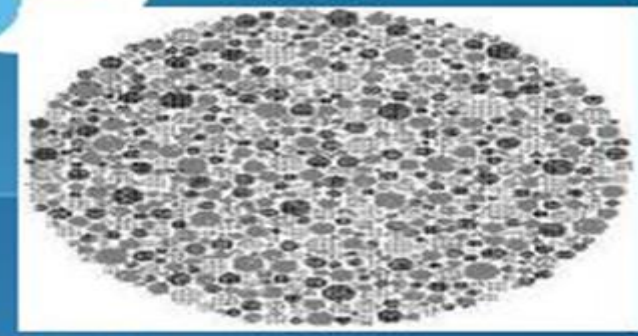

Huntington's Disease
35 or more
CAG repeats
Expanded
polyQ region
Chromosome 4
Mutated
HTT gene
Mutated
hHtt protein
Neuron
degeneration
Atrophy of basal ganglia,
enlargement of lateral ventricles

1-a. Cystic Fibrosis:

- Cystic fibrosis is a genetic disorder that affects the respiratory and digestive systems.
- People with cystic fibrosis inherit a defective gene on chromosome 7 called CFTR (cystic fibrosis transmembrane conductance regulator).
- The protein produced by this gene normally helps salt (sodium chloride) move in and out of cells.




Cross section of normal airway
airway wall
thin layer of mucus
outside cell
inside cell
chloride ions
Normal CFTR channel
Cross section of airway with cystic fibrosis
thick layer of mucus
mucus
Mutant CFTR channel

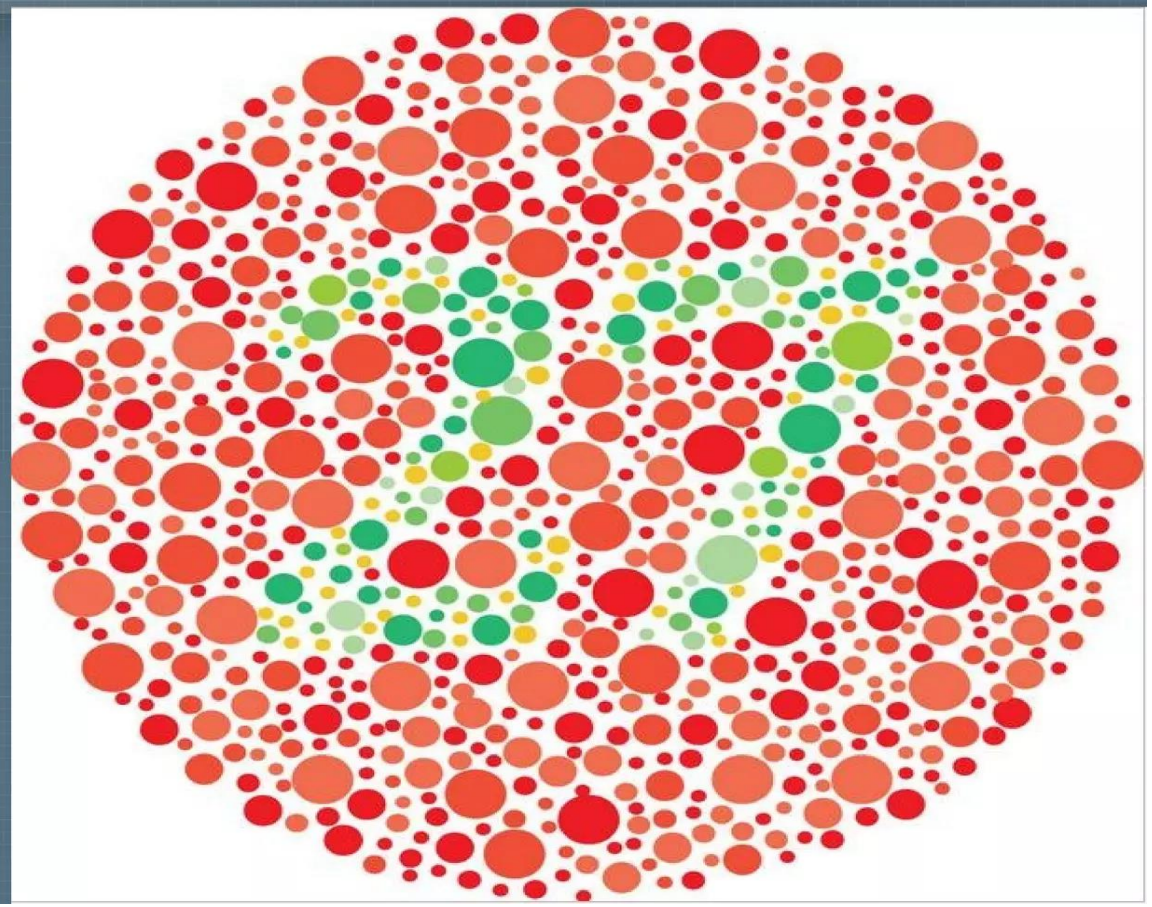


What is Color blindness???

- It is a genetic disorder that is the inability to distinguish different colors of the spectrum
- It's caused by X- linked mutation in either the long- (L) or the middle- (M) wavelength-sensitive visual photo pigments.
  - People diagnosed with color blindness can see limited range
  - In a rare condition you can only see shades of gray.
- Color blindness is a trait that is only found on the x- chromosome

Colorblindness:

- Mutated genes are located on the X-chromosome (for red/green color blindness) or both the X and Y chromosomes (for total color blindness).
- What about you? Try it:



Genes Responsible

- Mutations in the ***OPN1LW***, ***OPN1MW***, and ***OPN1SW*** genes cause the forms of color vision deficiency.
- The *OPN1LW*, *OPN1MW*, and *OPN1SW* genes provide instructions for making the **three opsin pigments** in cones

  OPN1LW-Long wavelength,located on X chromosome at position Xq28

  OPN1MW-Medium wavelength,position Xq28

  OPN1SW-Short wavelength, Chromosome 7 ,Position-7q32.1

- Genetic changes involving the *OPN1LW* or *OPN1MW* gene cause red-green color vision defects.These changes lead to an absence of L or M cones or to the production of abnormal opsin pigments.

Marfan Syndrome

- Marfan syndrome is an inherited connective tissue disorder
- Autosomal dominant
- Results from molecular defects in the *fibrillin gene*, (FBN1) on chromosome 15 (q15-q21)
- Impaired structural integrity of the skeletal, ocular, and cardiovascular systems

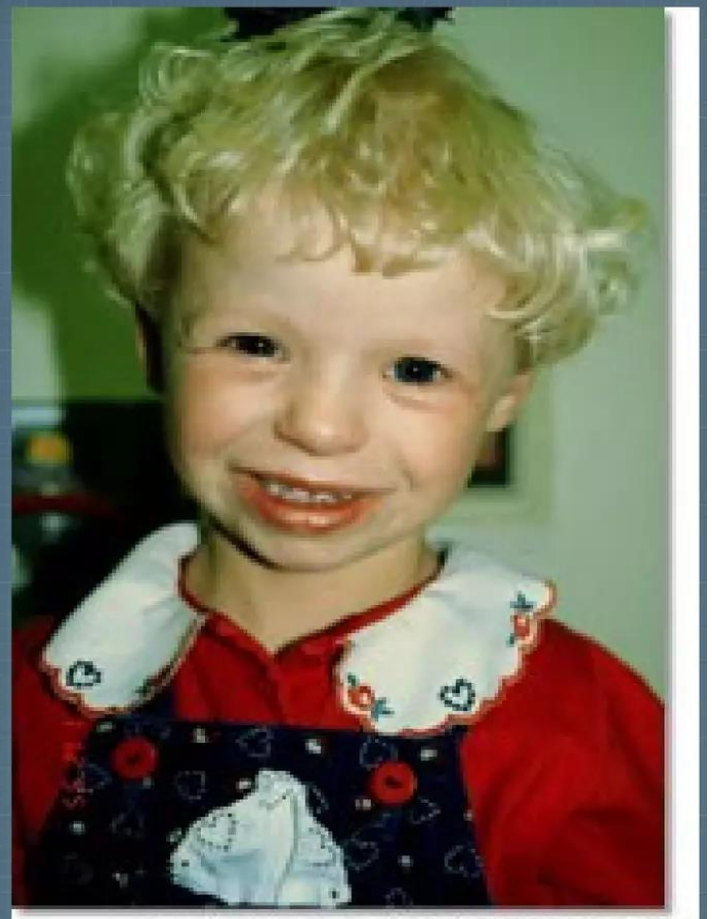
Angelman syndrome is a rare genetic disorder that affects the nervous system. Here are some key facts about Angelman syndrome:

Cause: Angelman syndrome is caused by the loss or malfunction of the UBE3A gene on chromosome 15. This gene is important for brain development and function.
 Individuals with Angelman syndrome often have a characteristic "happy puppet" appearance.


Angelman Syndrome

2-e. Williams Syndrome

- Williams syndrome is a rare genetic disorder that affects a child's growth, physical appearance, and cognitive development.
- People who have Williams syndrome are missing genetic material from chromosome 7, including the gene elastin.



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