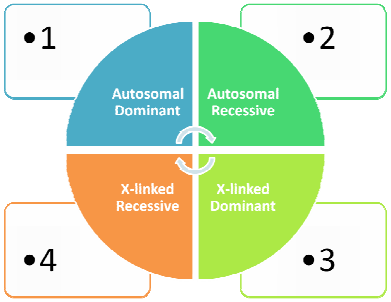
Autosomal Dominant and Recessive Inheritance

Classes of Monogenic Disorders



Examples of Monogenic Disorders

	Hutington Disease	
Autosomal	Marfan Syndrome	
	Polycystic Kidney disease	
	Sickle Cell anemia	
Autosomal	Cystic Fibrosis	
	Galactosemia	
X-linked	Hemophilia	

Autosomal Dominant Traits

- These are diseases caused by an **error in a single DNA gene**.
- Autosomal means the errors occurs on chromosome 1..22 rather than on the 23rd sex-linked X chromosome.
- Some examples of autosomal dominant diseases are **Huntington's disease** , **achondroplasia** (dwarfism), **Polycystic Kidney disease** and **Marfan Syndrome**

Dominance

- In dominant genetic diseases, the defective gene overcomes the normal gene and disease occurs
- there is a whole spectrum of levels of dominance, depending on how much damage a bad gene does and how adequately the second normal gene can compensate for the failing defective gene.
- a dominant disease affects a gene for a structural protein, causing malformed proteins that cause disease

Inheritance Pattern for Autosomal Dominant Disorders

- **No carriers**
- **Usually inherited**
- **Parent-to-child transmission**
- **Both affected parents to child transmission**
- **Double-dominant parent to child transmission**
- **Undiseased parents to child transmission**
- **Vertical inheritance**
- **Gender bias**

Double-dominance

- usually causes very severe disease or even spontaneous abortion or stillbirth.
- Double dominance is usually only possible for a child born to parents that both have the same dominant genetic disease,
- A double-dominant disease is like a recessive disease, except that carriers of it have the ordinary single-dominant condition.
- For example, the genetic dominant condition of **achondroplasia**(dwarfism)

Sporadic Genetic Disease

- A genetic disease that occurs when neither parent has any genetic defect.
- These cases arise via random genetic mutations in the DNA.
- A sporadic genetic mutation is more likely for a dominant disease than for a recessive genetic disease.

Chromosome Genetic Diseases

- These are genetic diseases where a large part of the **genetic code** has been disrupted.
- Chromosomes are long sequences of DNA that contain several genes.
- Humans have 2 copies of each of the 23 chromosomes

Causes of Chromosome Diseases

- arise from huge errors in the DNA that result from having **extra chromosomes, large missing sequences,** or **other major errors.**
- caused by a **random physical error** during reproduction and are **not inherited diseases**

Spontaneous Chromosome Errors

- arise spontaneously from parents where neither has the disease.
- elderly ladies are more likely to have babies with **Down syndrome**.
- Many chromosome errors cause the fetus to be aborted before birth, but some syndromes can be born and survive

Types of Chromosome Diseases

- There are several common types of chromosome errors that cause disease.
- The following major classes of chromosome diseases can occur:
  - **Trisomy conditions e.g.** Down syndrome
  - **Monosomy conditions e.g.** Turner syndrome).
  - **Sex chromosome conditions**

Rarer Types of Chromosome Diseases

- There are also some other rarer types of chromosome conditions that may lead to diseases
  - **Translocation disorders e.g.** Translocation Down Syndrome
  - **Subtraction disorders**
  - **Mosaicisim**
  - **One-sided chromosome disorders**

Non-contagiousness of chromosome diseases

- Genetic and chromosome diseases occur at birth.
- Not infectious diseases
- You are either born with the error in your chromosomes or not
- Genetic tests by **antenatal testing** for genetic diseases

1. Sex Chromosome Conditions

- **Sex chromosome defects:**
- **Turner syndrome** (XO syndrome, monosomy X, missing Y):
- **Klinefelter syndrome** (XXY syndrome, also rarely XXXY):
- **Jacobs syndrome** (XYY syndrome):
- **Triple-X** (XXX, also XXXX or XXXXX):

Note that there is no ordering, and XYX would be the same as XXY.

2. Autosomal Trisomy Chromosome Diseases

- **Down syndrome (trisomy 21):**
- **Edwards syndrome (trisomy 18):**
- **Patau syndrome (trisomy 13):**

Miscarriages Caused by Trisomy

- trisomies at autosomes 13, 15, 18, and 21.
- Trisomy at the other autosomes are probably fatal in embryos leading to **spontaneous miscarriage.**
- frequency of natural miscarriages, around 1-in-5,

Causes of Trisomy

- Down syndrome occurs more frequently in older women, one might theorize of the reason why.
- Aging mothers.
- ability to recognize wrong cells in a fetus is lost.
- uterus is an immune-privileged site during pregnancy.

3. Monosomy and Autosome Subtraction Disorders

- **Cri-du-chat syndrome (cat's cry):**
- **Prader-Willi Syndrome**

  (PWS) and Angelman Syndrome (AS):
- **Uniparental Disomy**

Polygenic Diseases

- polygenic diseases are affected by many genes.
- They have limited genetic basis.
- a child inherited a **genetic predisposition**
- E.g. **cancers, heart disease, autoimmune diseases**, etc.
- family history is a risk factor for the disease