

# **INTRODUCTION TO GENOME**

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# What is Genome?

**Full set of genes in each cell of an organism**

**Who We Are on the inside!**

AATTCATGAAAATCGTATACTGGTCTGGTACCGGCAACACTGAGAAAATGGCAGAGCTCATCGCTA  
AAGGTATCATCGAATCTGGTAAAGACGTCAACACCATCAACGTGTCTGACGTTAACATCGATGAAC  
GCTGACCGAAGGATCTGTCCTGGGTTGCTCTGCCATGGGCAATGAAGTTCTCGAAGAAAGCG  
AATTTGAACCGTTTCATCGAAGAGATCTCTACCAAATCTCTGGTAAGAAGGTTGCGCTGTTTCGGTTC  
TTACGGTTGGGGCGACGGTAAGTGGATGCGTGACTTCGAAGAACGTATGAACGGCTACGGTTGCG  
TTGTTGTTGAGACCCCGCTGATCGTTCAGAACGAGCCGGACGAAGCTGAGCAGGACTGCATCGAA  
TTTGGTAAGAAGATCGCGAACATCTAGTAGACGTGTCTGACGTTAAGACGTTAAGACGTTA

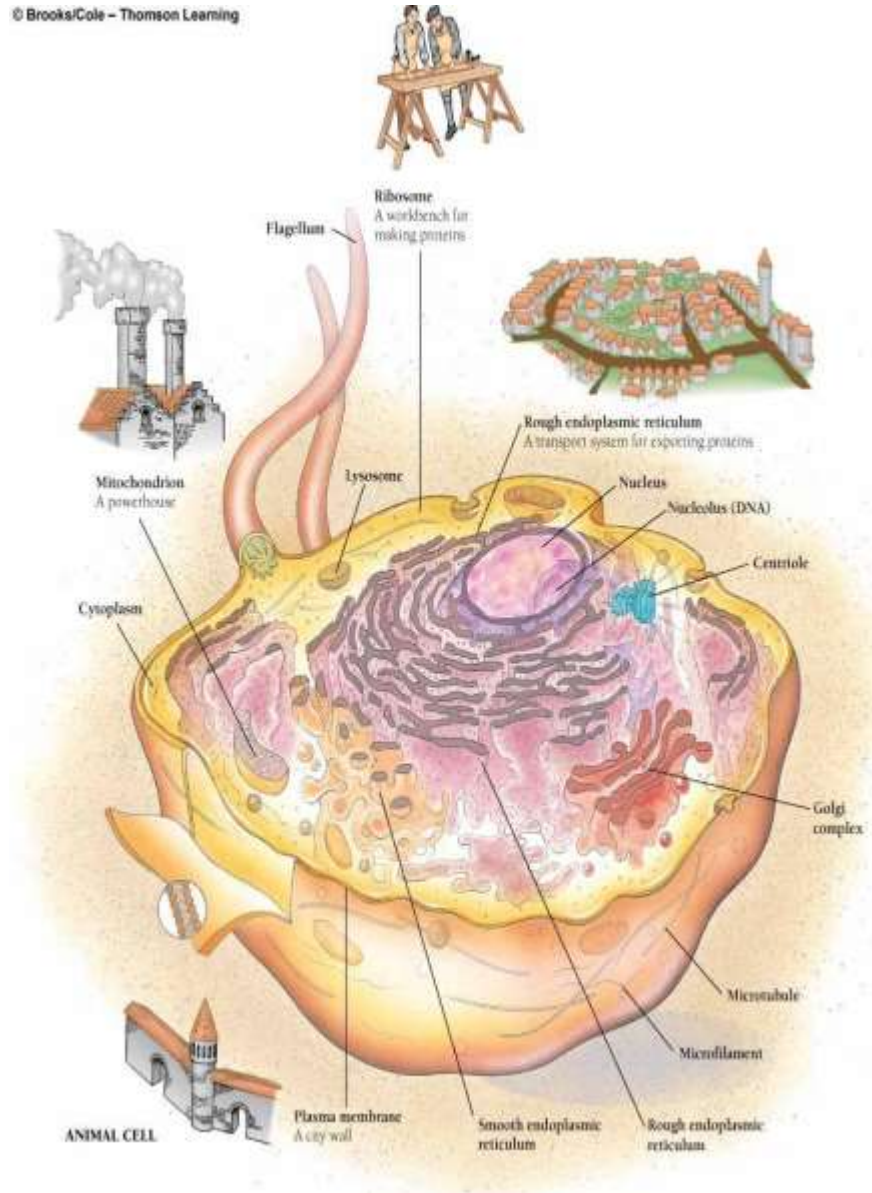
**The Genome is our Genetic Blueprint**



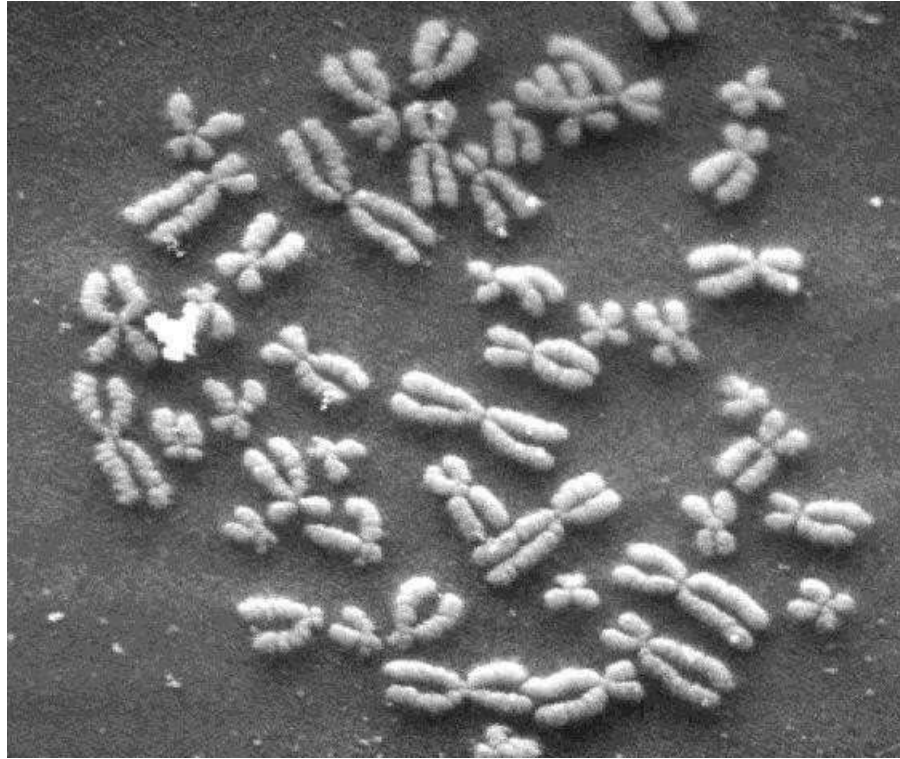
# Genes

- Basic structural and functional unit of genome
- Located on chromosomes
- Genetic information is carried in DNA and RNA
- Comes in multiple forms called alleles
- Control cells by directing protein synthesis.
- Human cells possess 46 chromosomes

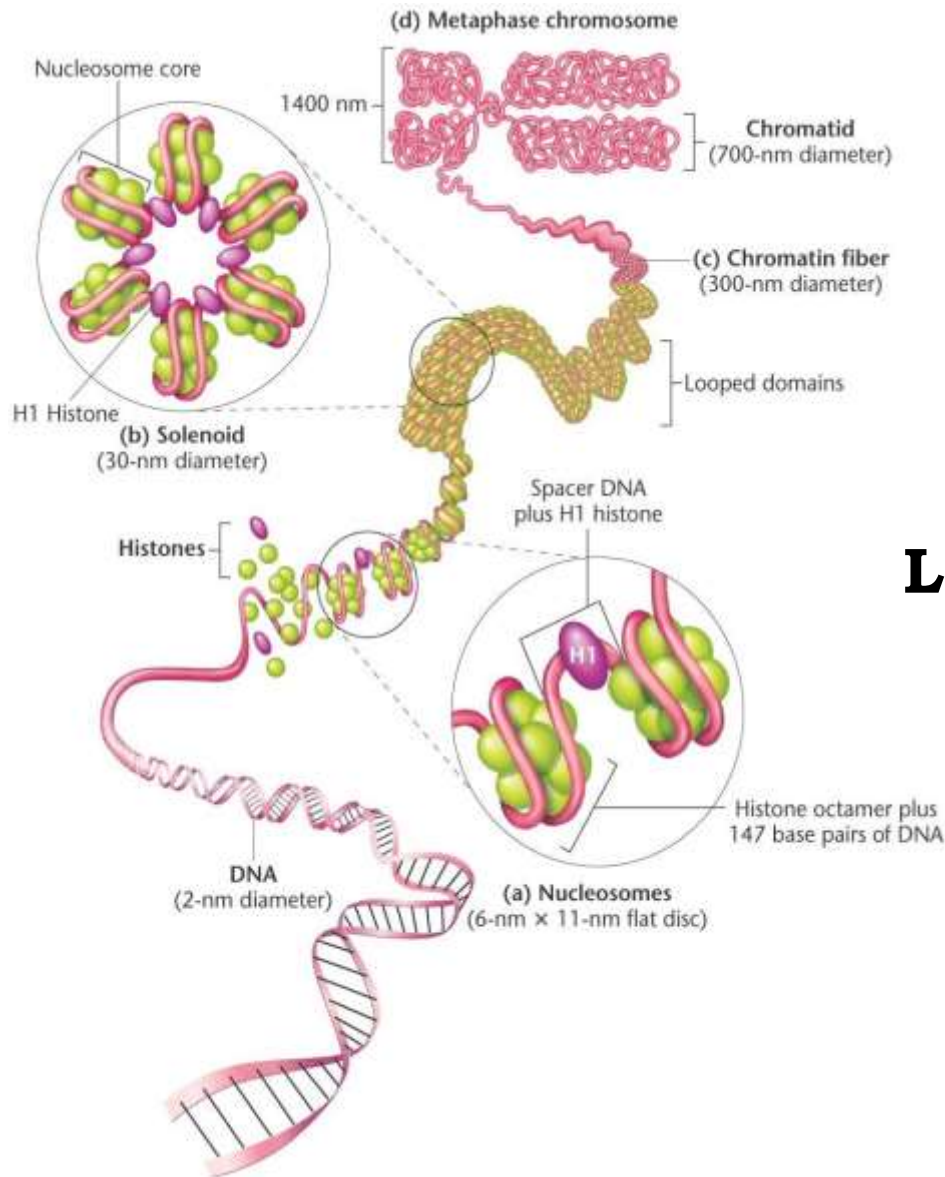
© Brooks/Cole – Thomson Learning



# Chromosomes



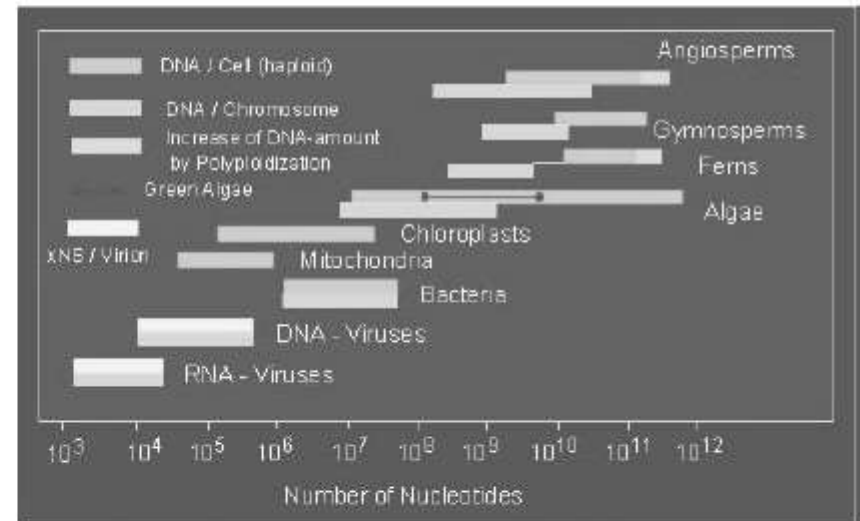
# How Is it organized ?



## Levels of DNA Condensation

# Genome size

- Units: bp, pg/1C
- Range:
  - Small: < 50 Mbp
  - Large: 120,000 Mbp
  - Some sizes:
    - *Cardamine amara*: 54 Mbp
    - *Arabidopsis thaliana*: 125 Mbp
    - *Prunus persica*: 270 Mbp
    - *Medicago truncatula*: 466 Mbp
    - *Oryza sativa*: 490 Mbp
    - *Lycopersicon esculentum*: 1,005 Mbp
    - *Zea mays*: 2,671 Mbp
    - *Triticum aestivum*: 16,979 Mbp



# Variation in genome size

- Plants:
  - Asterids: 0.3 – 24.8 pg
  - Rosids: 0.1 -- 16.5 pg
  - Ranunculales: 0.5 – 25.1 pg
  - Monocots: 0.3 – 127.4 pg
- Animals
  - Fruit fly 0.18 pg
  - Sea urchin 0.87
  - Chicken 1.13
  - Zebrafish 1.64
  - Mouse 3.01
  - Human 3.19
  - Octopus 4.56
  - Grasshopper 13.4
  - Salamander 38.3
  - Lungfish 140

# Genome Size

*Amoeba dubia*  
670000 Mb



*Amoeba proteus*  
290000 Mb



*Allium cepa*  
17000 Mb



*Bufo bufo*  
6900 Mb



*Homo sapiens*  
3000 Mb



*Rhinolophus*  
1929 Mb



*Arabidopsis*  
125 Mb



*Drosophila melanogaster*  
120 Mb



*Caenorhabditis elegans*  
97 Mb



*Saccharomyces cerevisiae*  
12 Mb



*E. Coli* 4.1 Mb



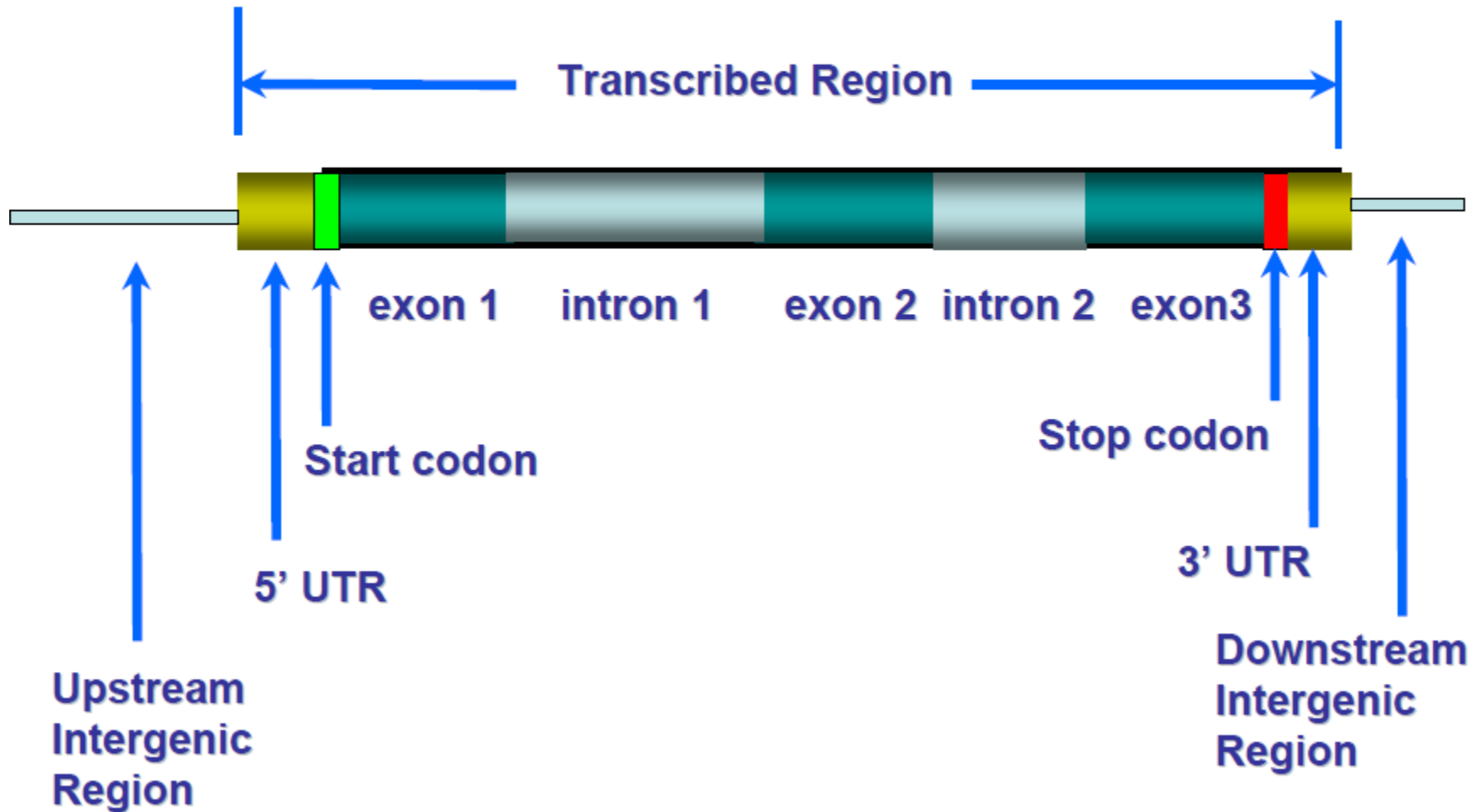
Human  
immunodeficiency  
virus type 1  
0.19Mb



# Eukaryotes

- **Complex gene structure**
- **Large genomes (0.1 to 10 billion bp)**
- **Exons and Introns (interrupted)**
- **Low coding density (<30%)**
  - 3% in humans, 25% in Fugu, 60% in yeast
- **Alternate splicing (40-60% of all genes)**
- **High abundance of repeat sequence (50% in humans) and pseudo genes**
- **Nested genes: overlapping on same or opposite strand or inside an intron**

# Eukaryotic Gene Structure



# Repetitive DNA

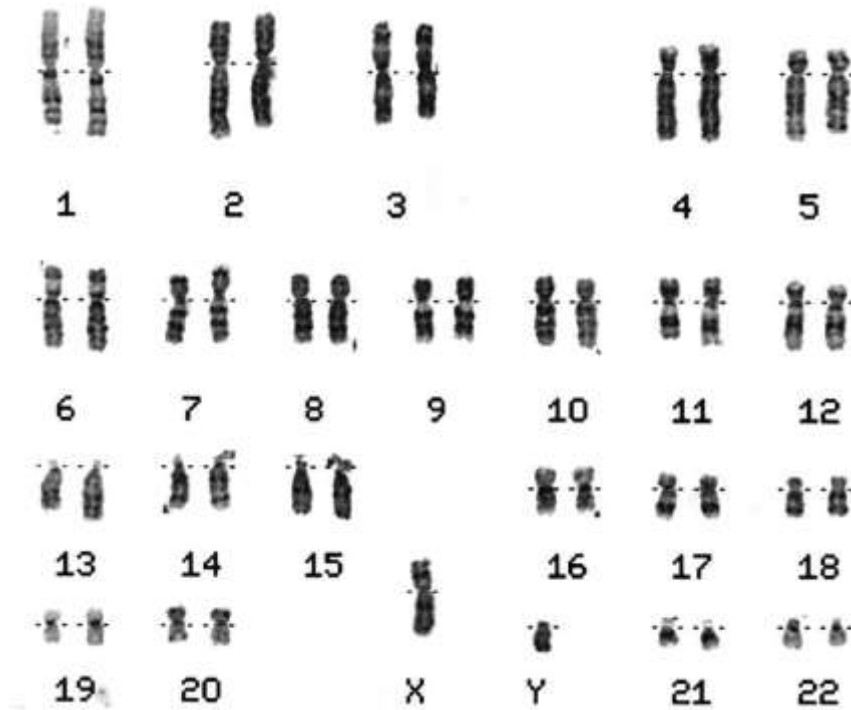
- **Moderately Repetitive DNA**
  - Tandem gene families (250 copies of rRNA, 500-1000 tRNA gene copies)
  - Pseudogenes (dead genes)
  - Short interspersed elements (SINEs)
    - 200-300 bp long, 100,000+ copies, scattered
    - Alu repeats are good examples
  - Long interspersed elements (LINEs)
    - 1000-5000 bp long
    - 10 - 10,000 copies per genome

# Repetitive DNA

- **Highly Repetitive DNA**
  - **Minisatellite DNA**
    - repeats of 14-500 bp stretching for ~2 kb
    - many different types scattered thru genome
  - **Microsatellite DNA**
    - repeats of 5-13 bp stretching for 100's of kb
    - mostly found around centromere
  - **Telomeres**
    - highly conserved 6 bp repeat (TTAGGG)
    - 250-1000 repeats at end of each chromosome

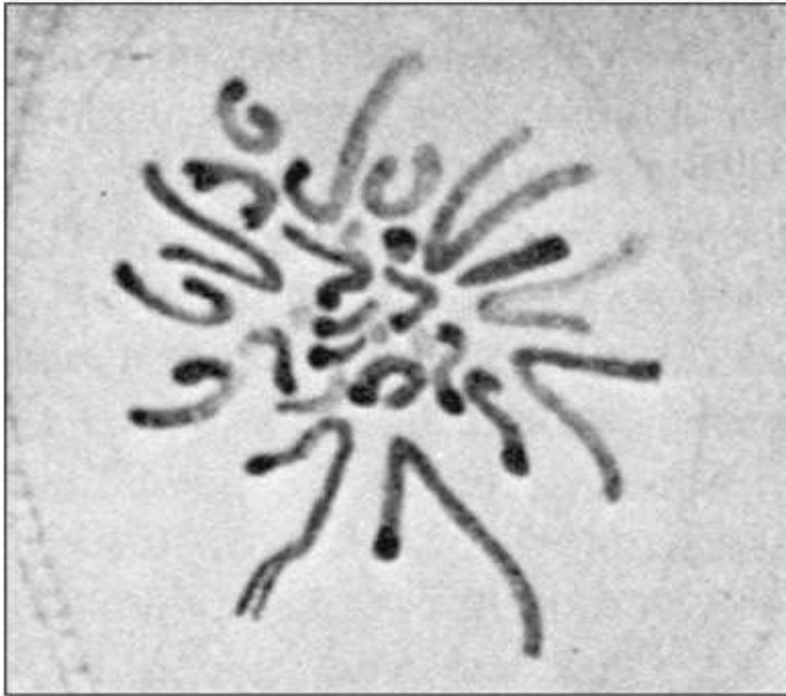
# Cytogenetics

- Studies on chromosome number & structure



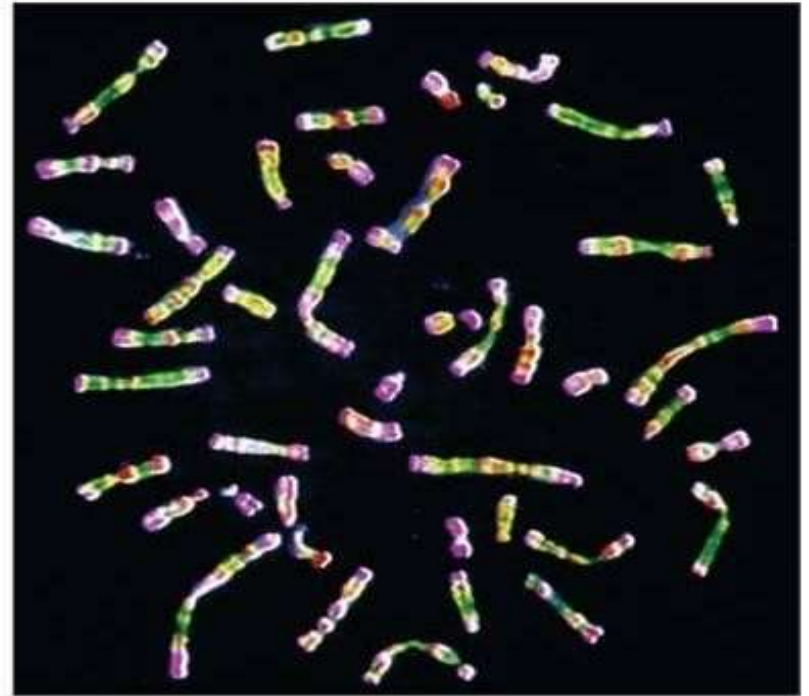
# Cytogenetics: Then & Now

1882



Drawing by German biologist  
Walther Flemming

Now



Micrograph of actual stained  
human chromosomes