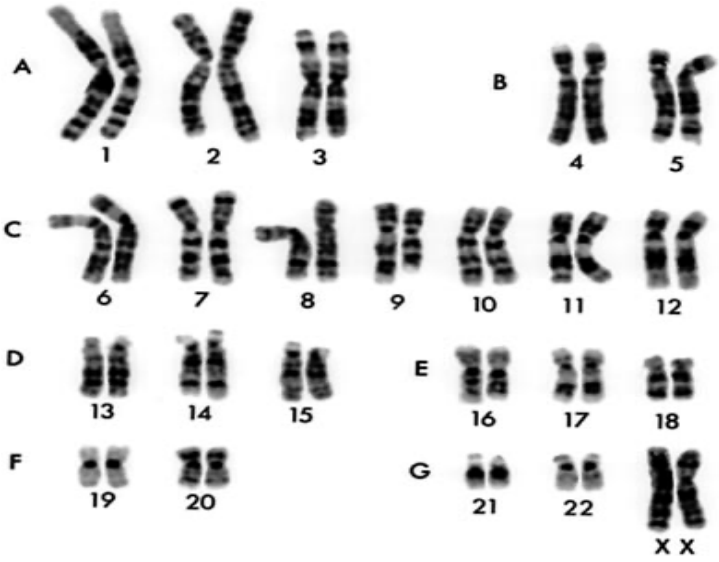
A. HOMOLOGOUS CHROMOSOMES

- Chromosomes are found in **pairs** inside **body** cells.
- Humans have **23 pairs** of **homologous** chromosomes.
- In **each pair**, one chromosome is from **mum** and the other is from **dad**.
- Pairs **1-22** are called **autosomes** as they are **non-sex** chromosomes.
- Pair **23** is the **sex chromosomes** as they carry genes that determine our sex.



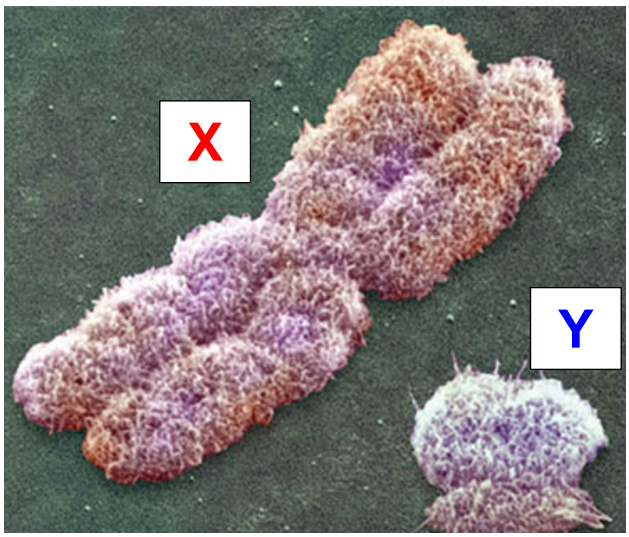
Homologous chromosomes are the same shape and size.

They carry the same genes in the same sequence.

However, they carry different alleles.

B. SEX CHROMOSOMES

The **X**-chromosome is **larger**

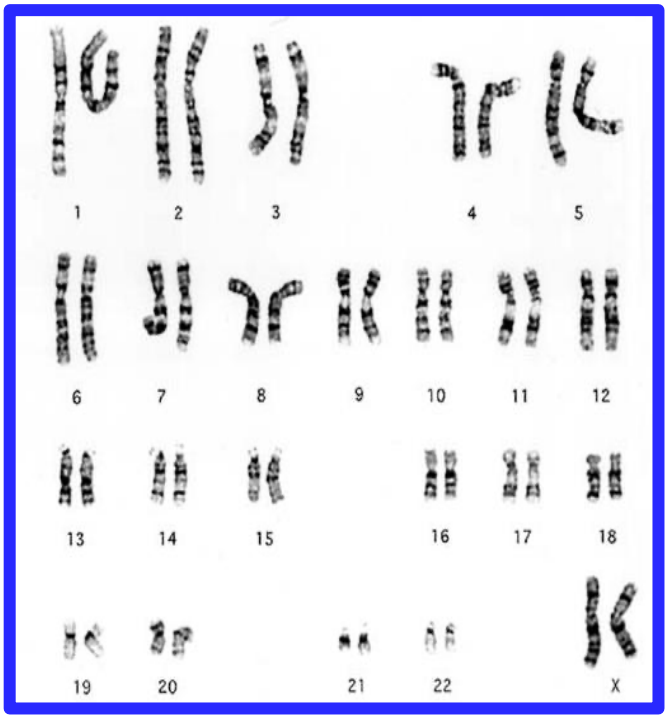


The sex chromosomes carry **genes** that **determine sex**.

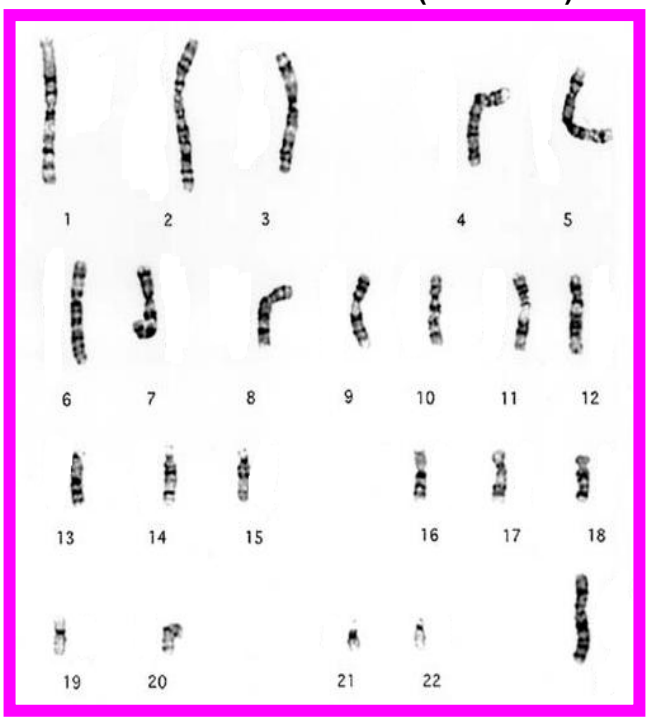
However, they also carry **other genes** that have nothing to do with determining sex.

C. DIPLOID AND HAPLOID CELLS

DIPLOID BODY CELL



HAPLOID SEX CELL (GAMETE)

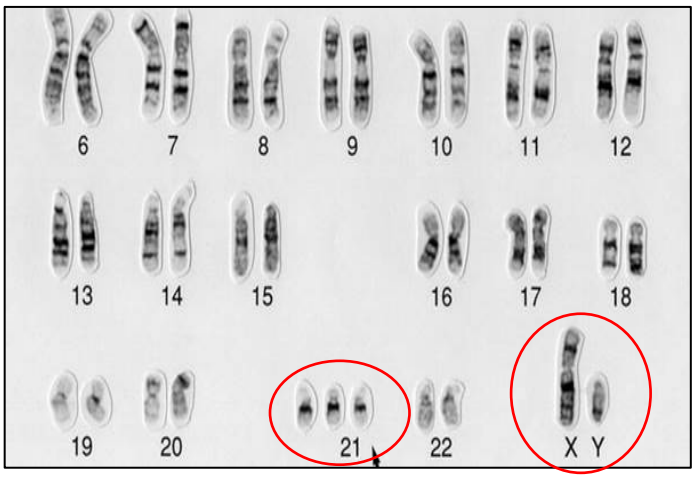


Nucleus contains:	
Pairs of **homologous** chromosomes	**Unpaired single** chromosomes
2 copies of each chromosome	**1** copy of each chromosome
e.g. liver cells, eye cells, brain cells	e.g. sperm and egg cells only

D. KARYOTYPES AND KARYOGRAMS

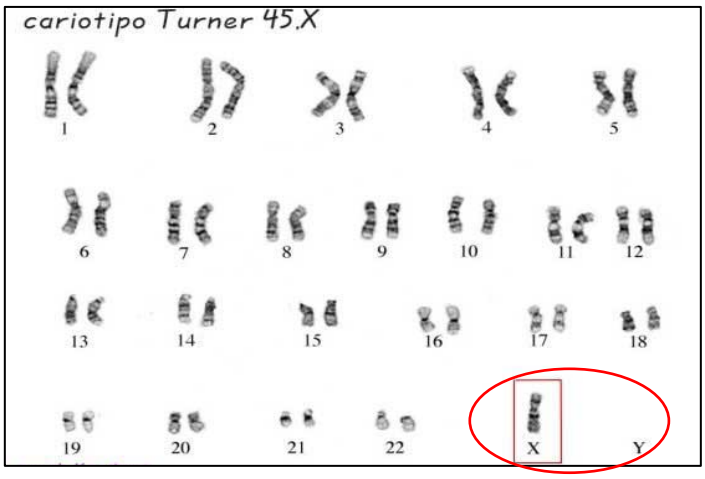
- A **karyotype** is the **number** and **type** of **chromosomes** present in a cell or organism.
- A **karyogram** is a **photograph** or **diagram** in which the **chromosomes** of an organism are shown in **homologous pairs** of **decreasing length**.

DOWN SYNDROME



3 copies of chromosome **21** (='**Trisomy 21**')
This person is **male**

TURNER'S SYNDROME



1 X chromosome and **no Y** chromosome
This person is **female**

- To produce a **karyogram**, cells are **stopped dividing** in **metaphase** of **mitosis**.
- Chromosomes are shown as **homologous pairs** of **decreasing length**.
- Their **length**, **banding pattern** and **position of the centromere** are used to **pair** them.

E. GENOMES

The GENOME is all the GENES in a cell, tissue or organism

The PROTEOME is all the different PROTEINS that can be produced by a cell, tissue or organism

- The **genome** is **fixed** – it is the **same** in **every type** of body cell.
- The **proteome** is **variable** – **different cell types** produce **different proteins**.
- The **genome size** is the **total amount of DNA,** measured in **millions of base pairs**.

Organism	Genome size (millions of base pairs of DNA)
T2 phage (virus)	0.18
Escherichia coli (bacterium)	5
Drosophila melanogaster (fruit fly)	140
*Homo sapien (*human)	3,000
Paris japonica (woodland plant)	150,000

- **Viruses** and **bacteria** tend to have **very small** genomes.
- **Prokaryotes** typically have **smaller** genomes than **eukaryotes**.
- **Plant** genome sizes can **vary dramatically** due to plant species being able to **self-fertilise** and become **polyploid**.

F. DIPLOID NUMBER OF DIFFERENT SPECIES

Organism	Diploid number of chromosomes
Human	46
Chimpanzee	48
Dog	78
Rice	24
Threadworm	4

- **Each** species has a **specific diploid number** of chromosomes.
- This is the **total number** of **chromosomes** in the **body** cells.
- It **varies considerably** between species.
- It **does not tell us** the **size** of the **chromosomes** or **how many genes** they contain.

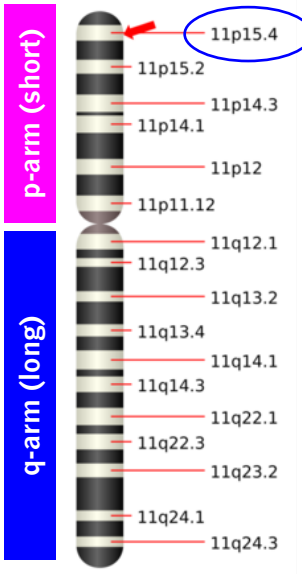
G. PROKARYOTIC AND EUKARYOTIC CHROMOSOMES

Prokaryotic chromosomes	Eukaryotic chromosomes
Circular DNA molecule	**Linear (straight)** DNA molecule
Not associated with **histone** proteins	**Associated** with **histone** proteins
One chromosome only	**Two or more** different chromosomes
Plasmids often **present**	**No** plasmids
No introns, only exons	**Introns and exons**
One replication/initiation point	**Many** replication/initiation points

HL

H. LOCUS

- This is the **position** of a **gene** of a **chromosome**.

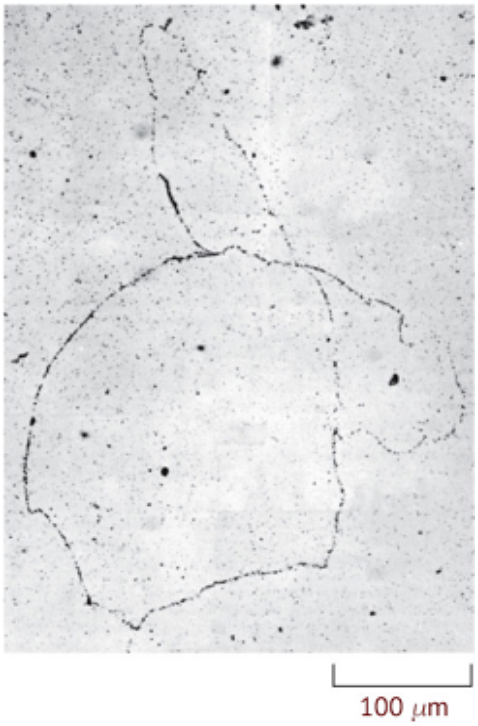


This gene is:

- on **chromosome 11**
- on the **p(short) arm** of the chromosome
- at **specific location 15.4**

I. JOHN CAIRNS AND AUTORADIOGRAPHY

- *E. coli* bacteria were cultured in a medium containing **radioactively**-labelled **thymine** to label its **DNA**.
- Radioactive cells were placed on a **membrane** and their **cell walls** were **digested**, allowing their **DNA** to **leak out**.
- The membrane was coated with a photographic film and left in the dark for two months.
- The **film** was then **developed** and **lines of black dots** showed the **position** of **DNA** molecules.
- He showed that the **DNA** molecules were **circular**.
- Using this technique with **electron microscopy** made it also possible to measure the **length** of **DNA** molecules.

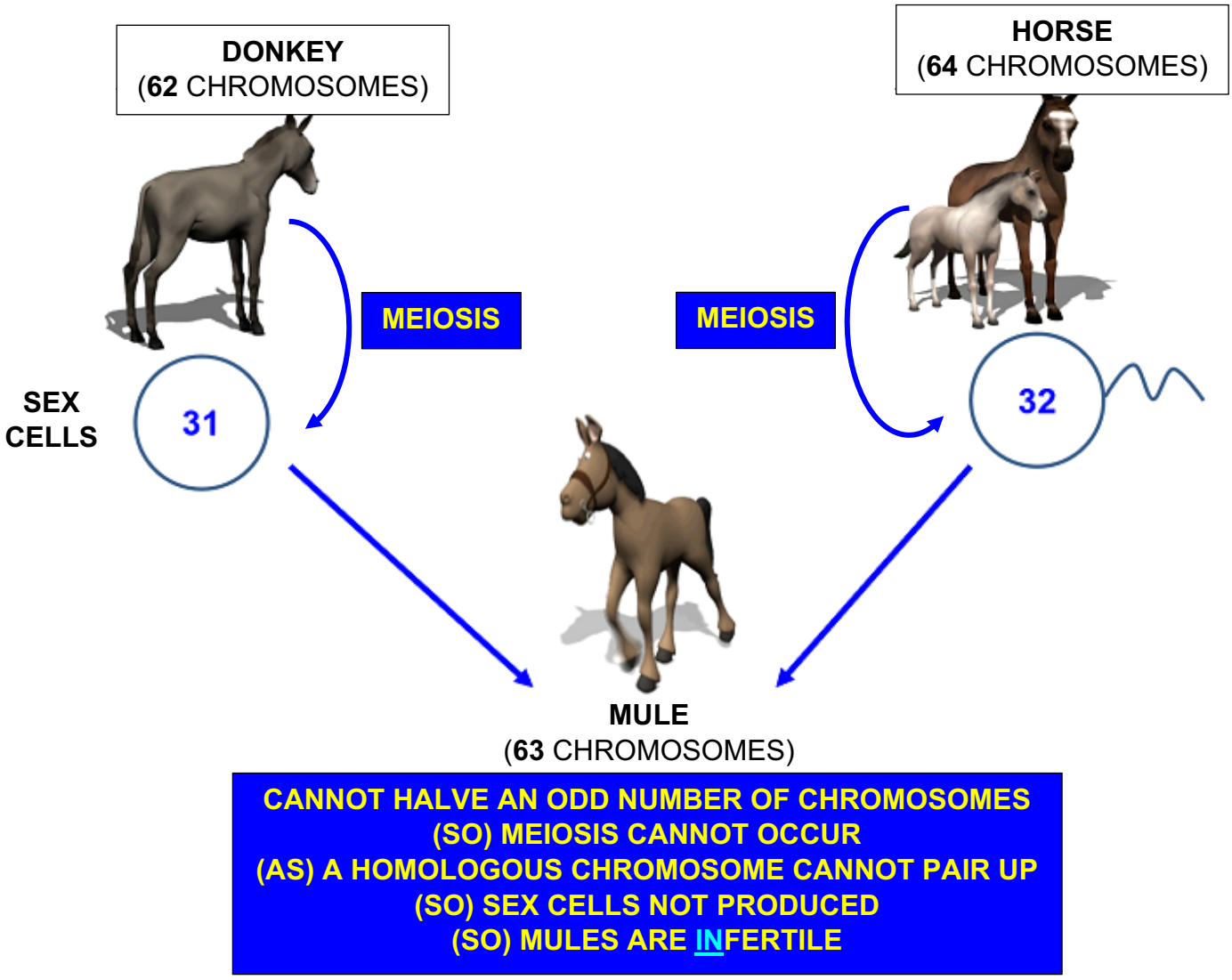


J. SPECIES

Organisms of the SAME SPECIES can BREED together to produce **FERTILE** OFFSPRING

Organisms of the SAME SPECIES have the **SAME DIPLOID NUMBER** of CHROMOSOMES

- Donkeys and horses **can** breed together to produce a **mule**:



CANNOT HALVE AN ODD NUMBER OF CHROMOSOMES
(SO) MEIOSIS CANNOT OCCUR
(AS) A HOMOLOGOUS CHROMOSOME CANNOT PAIR UP
(SO) SEX CELLS NOT PRODUCED
(SO) MULES ARE INFERTILE