Genetics: Meiosis

BMC Spring 2023
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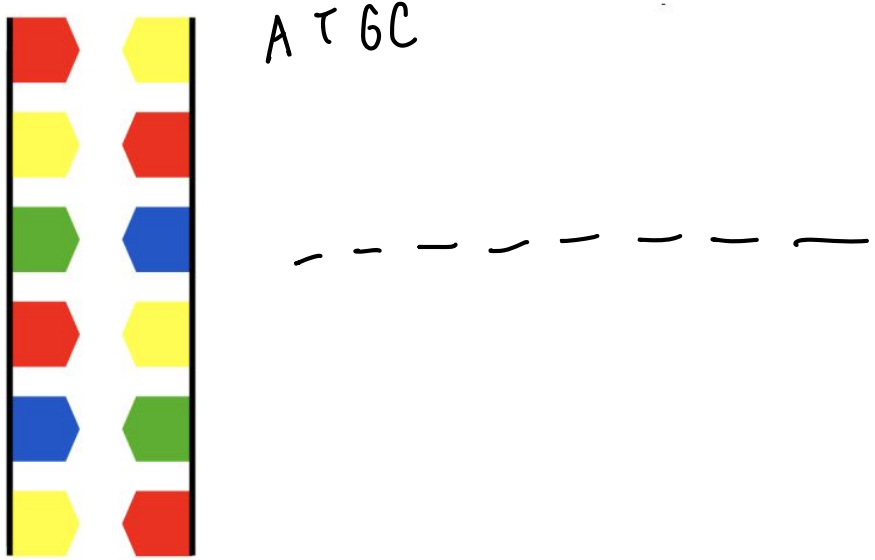
What is genetics?

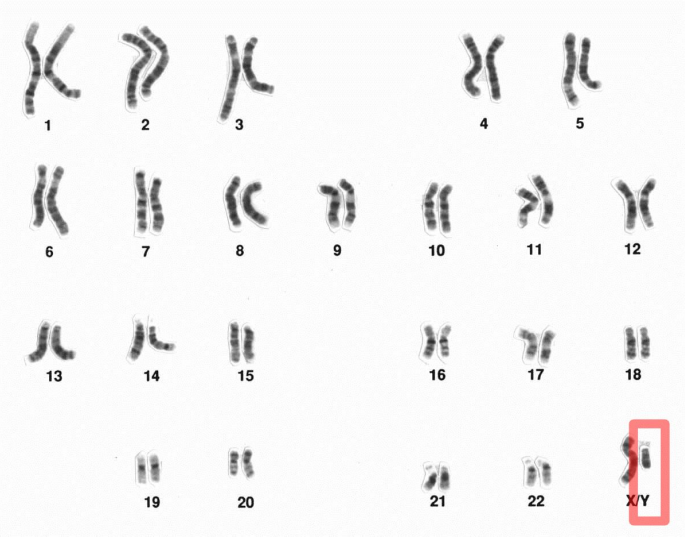
Genetics includes:

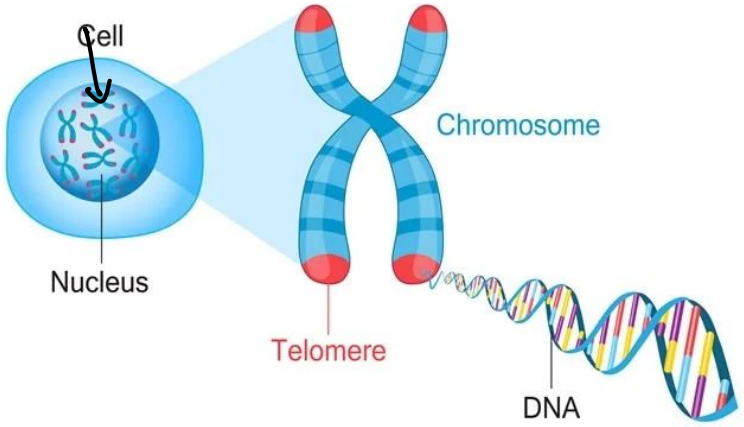
- Study of genes
  - Their associated phenotype (physical trait)
  - Their heredity
- Study of association between a gene and the phenotype it associates with

DNA stores information



Chromosomes – scaffold for genes

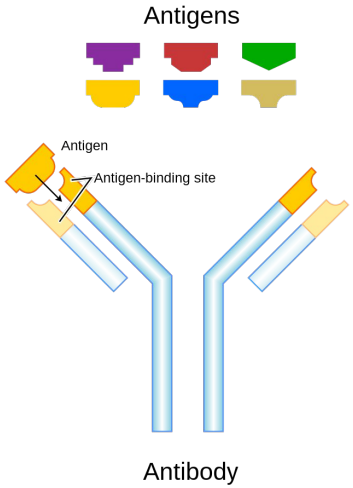




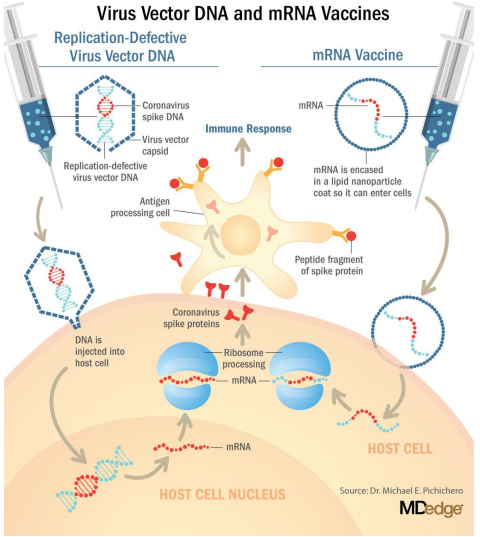
Genes can be defined as what is passed on from parent to offspring, and they give rise to traits

More physically it's a stretch of DNA

Proteins are not just for bodybuilders



Antibody proteins sense pathogens



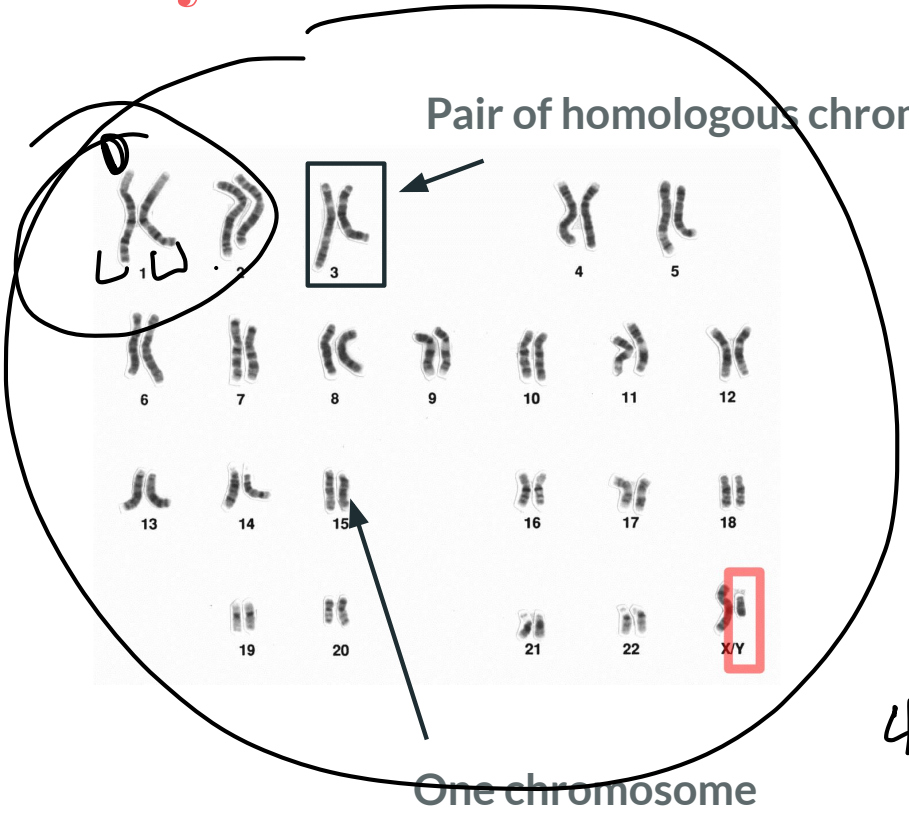
COVID vaccine

What is meiosis?

Meiosis is a series of cell divisions that create egg or sperm

- In males: occurs after hitting puberty and beyond
- In female: occurs during fetal development
- Involves the separation of homologous chromosomes

Every individual carries two sets of chromosomes



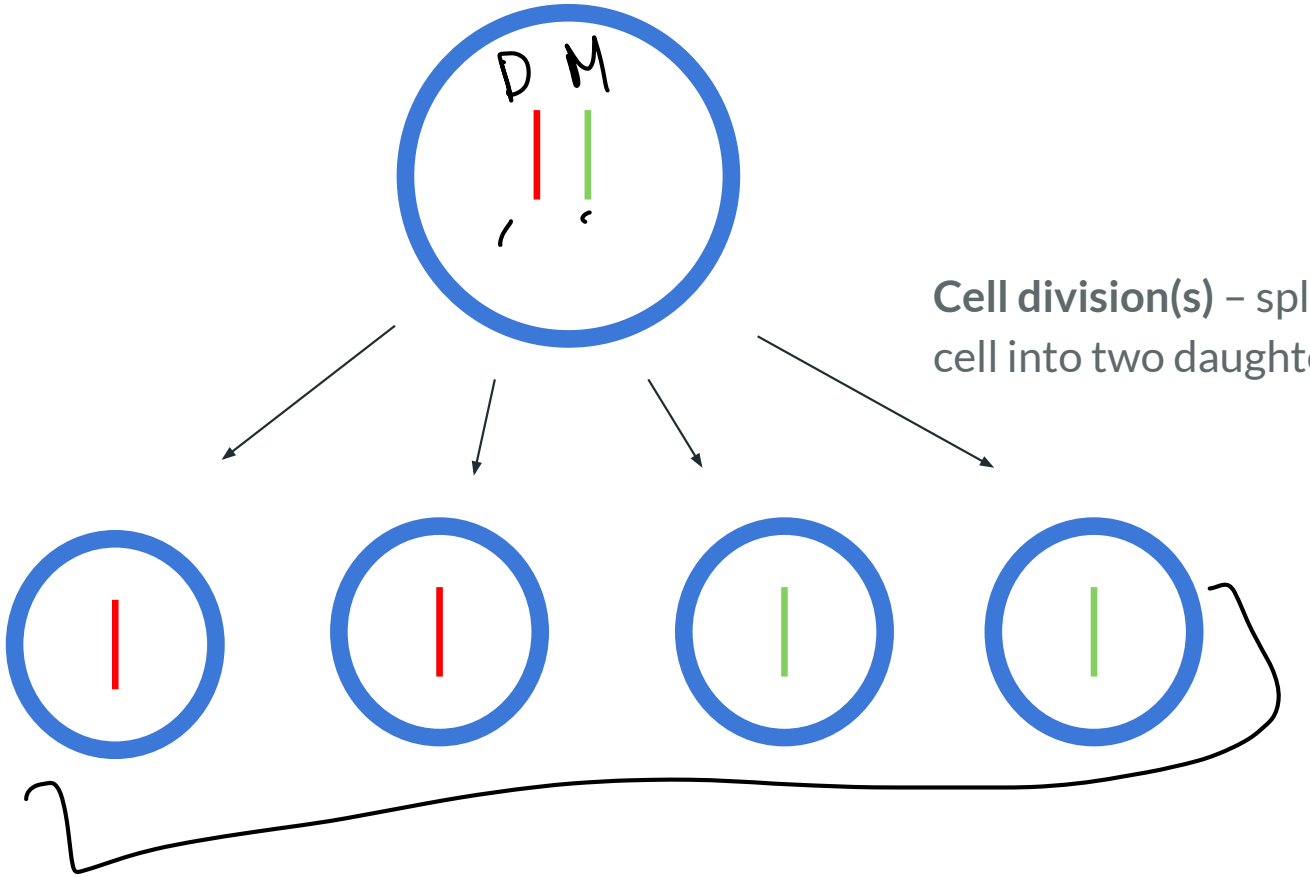
Homologous chromosomes – chromosomes with same pattern of genes, but not necessarily the same version of the gene

Diploid – carrying two sets of chromosomes

Each chromosome contains up to ~2,000 genes

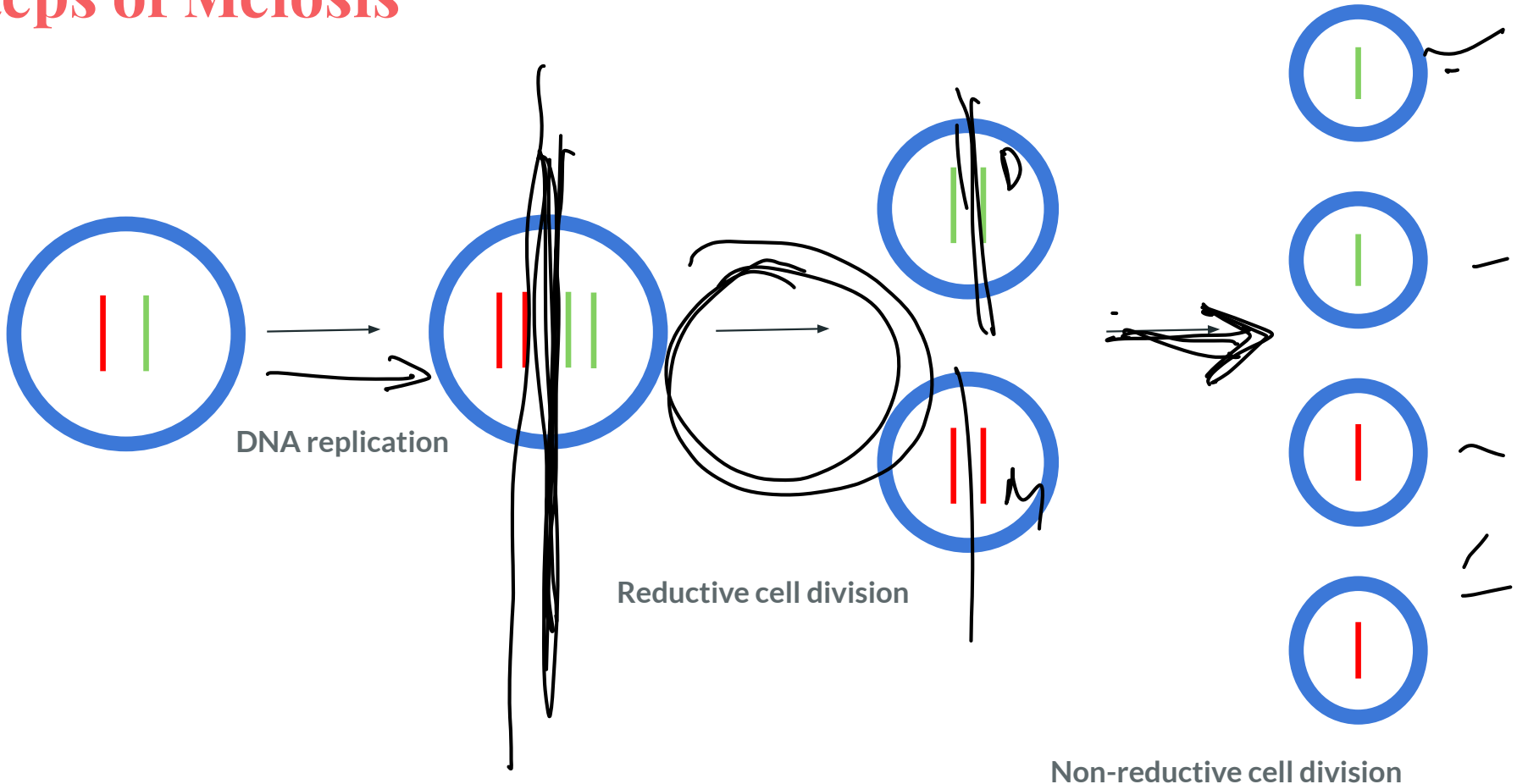
46 chromosomes / cells

Meiosis produces cells with one copy of all chromosomes



Cell division(s) – splitting of one cell into two daughter cells

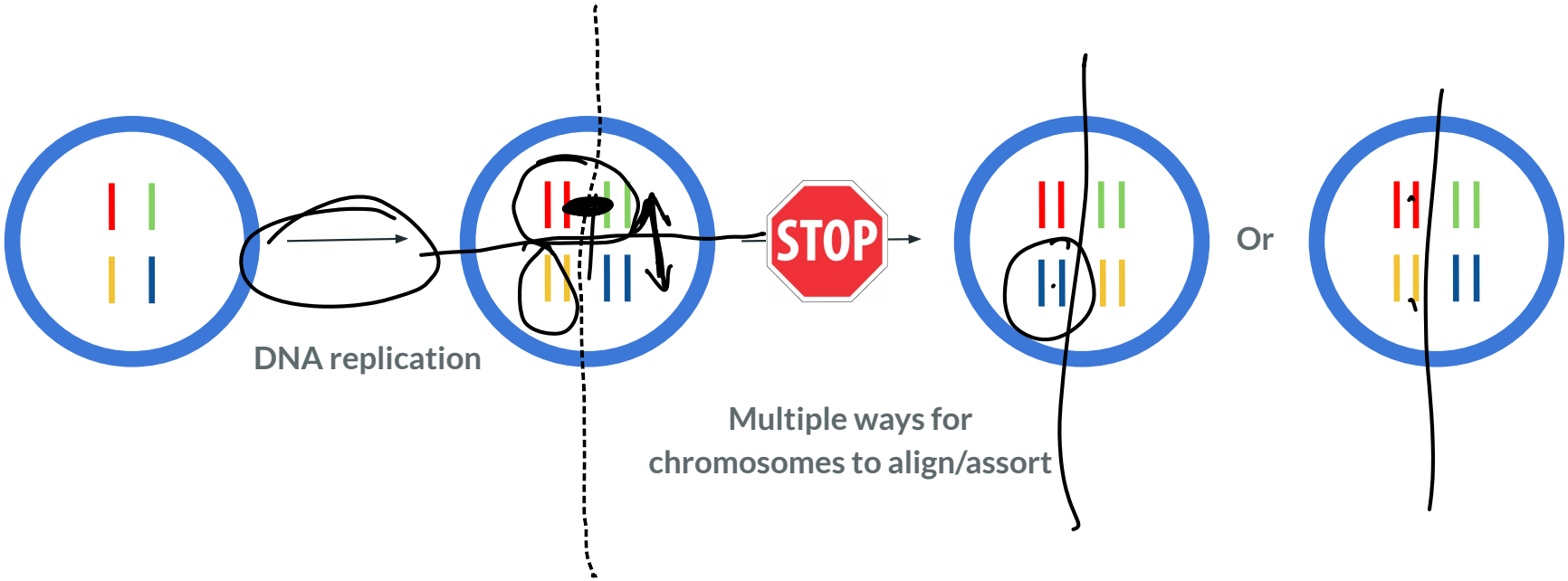
Steps of Meiosis



Unlinked Genes

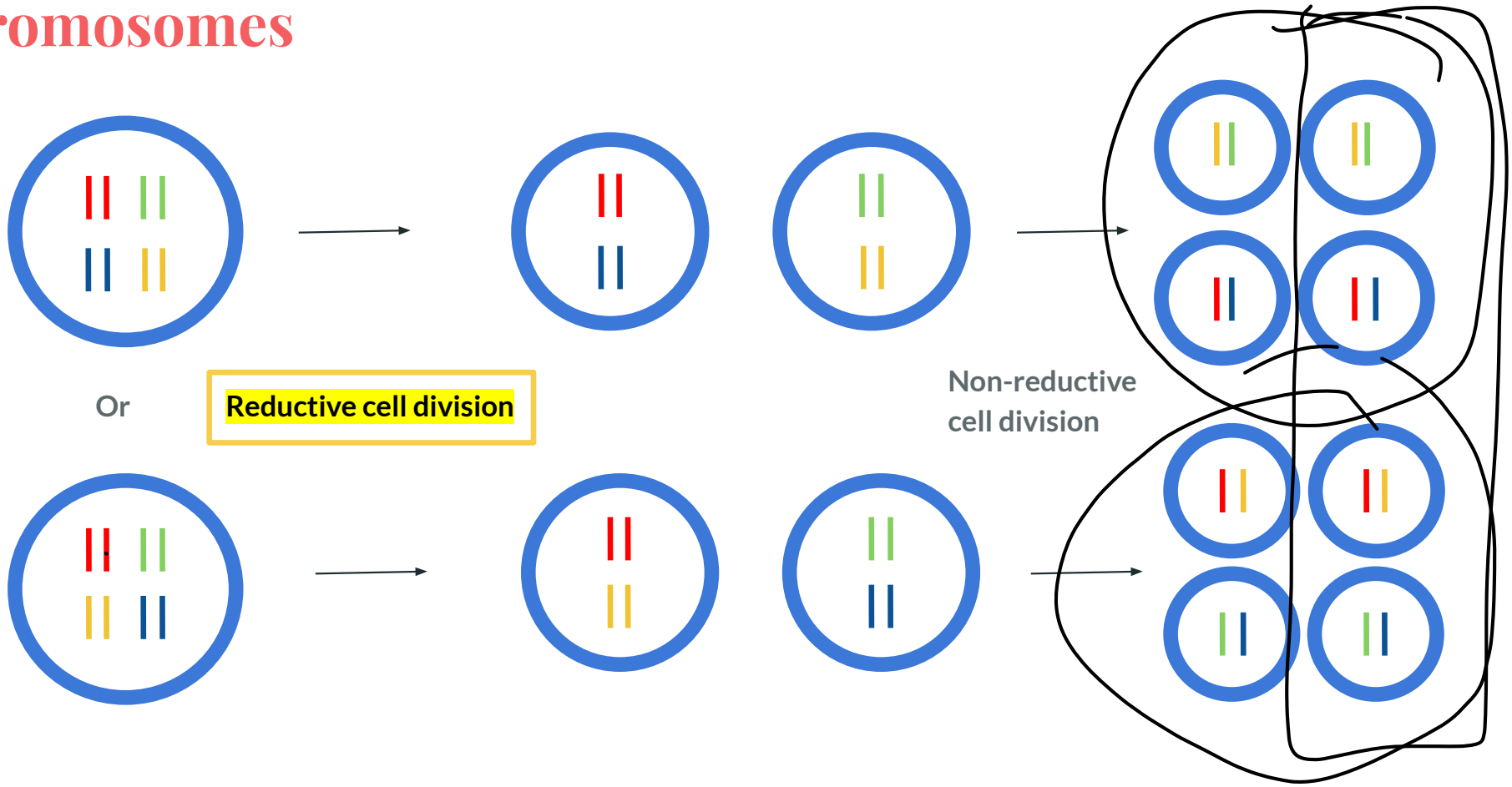
Genes that appear to be on two different chromosomes

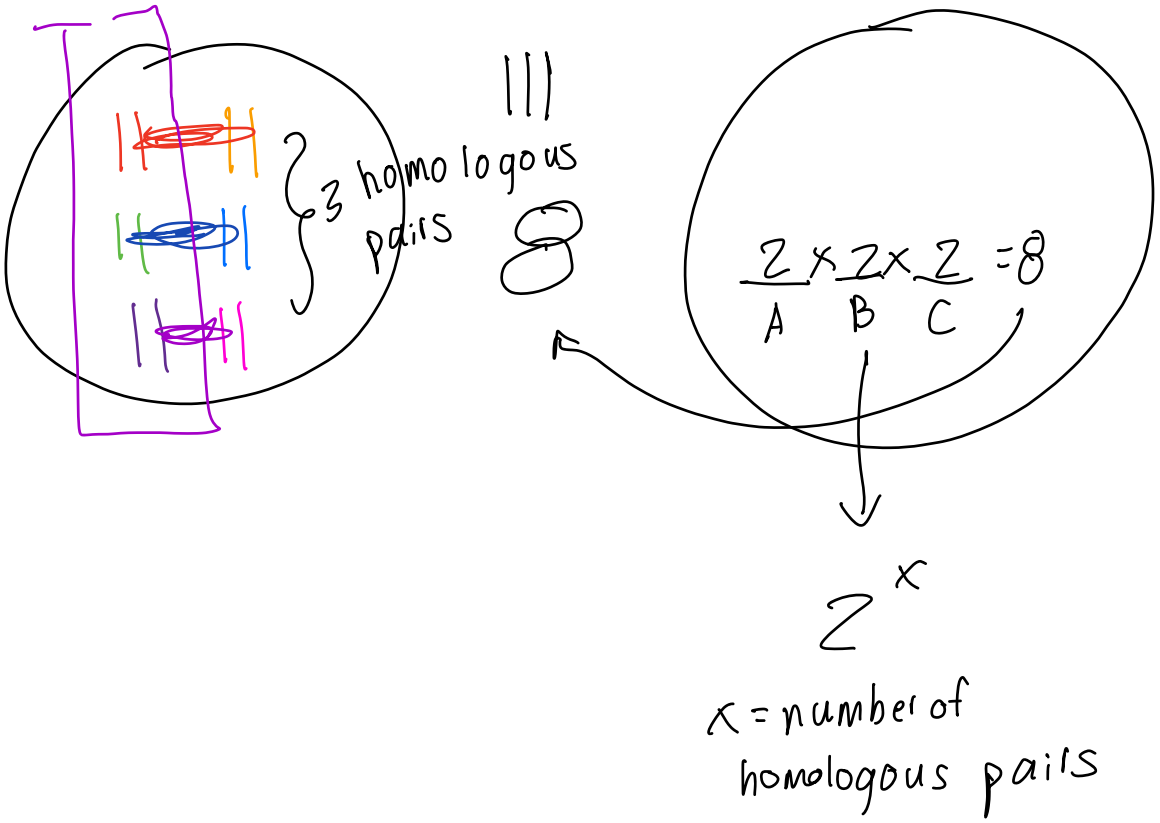
Meiosis with two pairs of homologous chromosomes



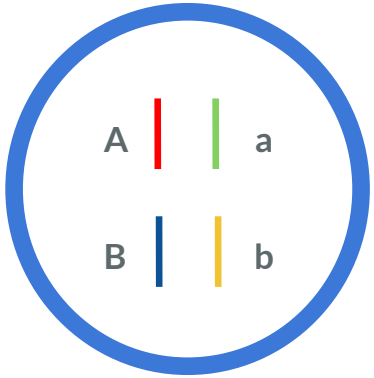
Assortment of different pairs of homologous chromosomes are <u>independent</u> of each other

Reductive cell division with two pairs of homologous chromosomes




3 homologous pairs
2 x 2 x 2 = 8
A B C
2^x
x = number of homologous pairs

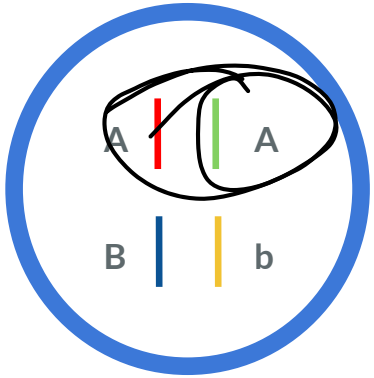
Calculating possible combinations of daughter cells



$\frac{2}{A} \times \frac{2}{B} = 4$

AB Ab aB ab

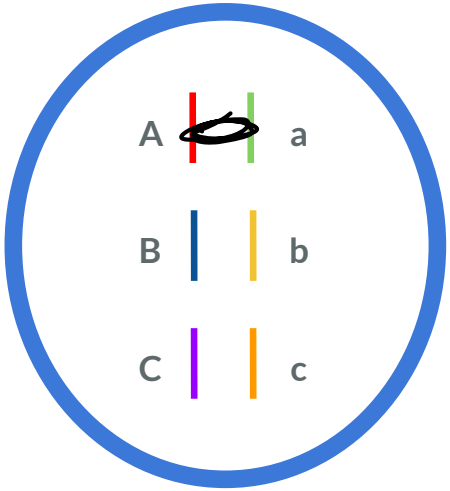
Calculating combinations of daughter cells: heterozygosity v. homozygosity



$\frac{1}{A} \times \frac{2}{B} = 2$

AB Ab AB Ab

Calculating combinations of daughter cells: 3 unlinked genes



$\underset{A}{2} \times \underset{B}{2} \times \underset{C}{2} = 8$

$2^{23} = 8,388,608$

Humans:

23 pairs of homologous pairs of chromosomes

Strawberries:

octuplets of homologous chromosomes

10 octuplets

8^{10}

$8 \times 8 \times 8 \times 8 \text{ — — — ..} = 8^{10}$ assuming every

7 octuplets

8^7 daughter cell combinations

20 c