

## 5.2 Meiosis and Genetic Diversity

Sister chromatids remain attached

Homologous chromosomes separate

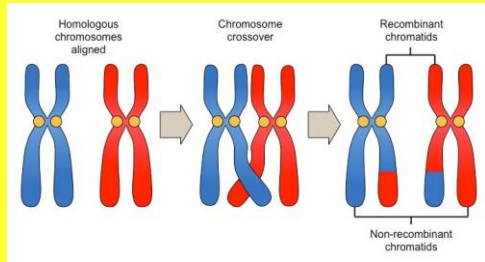
Organism	Body Cell (2n)	Gamete (n)
Human	46	23
Garden pea	14	7
Fruit fly	8	4
Tomato	24	12
Dog	78	39
Chimpanzee	48	24
Leopard frog	26	13
Corn	20	10

## ENDURING UNDERSTANDING

IST-1 Heritable information provides for continuity of life.

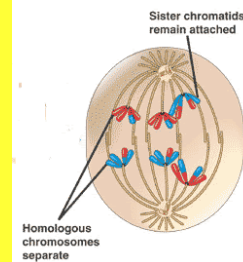
### IST-1.H Explain how the process of meiosis generates genetic diversity.

- During meiosis I, homologous chromatids exchange genetic material via a process called “crossing over” (recombination), which increases genetic diversity among the resultant gametes.



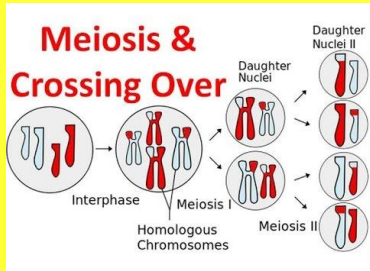
### IST-1.H Explain how the process of meiosis generates genetic diversity.

- Separation of the homologous chromosomes in meiosis I ensures that each gamete receives a haploid (1n) set of chromosomes that comprises both maternal and paternal chromosomes.



### IST-1.H Explain how the process of meiosis generates genetic diversity.

- Sexual reproduction in eukaryotes involving gamete formation—including crossing over, the random assortment of chromosomes during meiosis, and subsequent fertilization of gametes—serves to increase variation.



## Fertilization

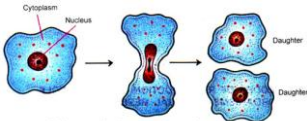
- Involves the fusion of two gametes
- Increases genetic variation in populations by providing for new combinations of genetic information in the zygote
- Restores the diploid number of chromosomes.

Organism	Body Cell (2n)	Gamete (n)
Human	46	23
Garden pea	14	7
Fruit fly	8	4
Tomato	24	12
Dog	78	39
Chimpanzee	48	24
Leopard frog	26	13
Corn	20	10

## Significance of Meiosis

- Produces genetic variation.
  - Asexual organisms depend primarily on mutations to generate variation
  - Variation provides for adaptations to changing environment.
- Keeps chromosome numbers constant in species
- Ensures daughter cells receive one of each kind of gene

Chromosome number in various organisms	
organism	Total number of chromosomes
Human	46
Cat	38
Dog	78
Pig	38
Goat	60
Sheep	54
Cattle	60
Horse	64
Donkey	62
Rabbit	44
Chicken	78



## Significance of Meiosis

- Independent assortment provides  $2^n$  possible combinations of chromosomes in daughter cells.
  - In humans with 23 haploid chromosomes,  $2^n = 2^{23} = 8,388,608$  possible combinations.
  - Variation is added by crossing-over; if only one crossover occurs within each tetrad,  $4^{23}$  or 70,368,744,000,000 (70 trillion) combinations are possible.
  - Fertilization also contributes to genetic variation;  $(2^{23})^2 = 70,368,744,000,000$  possible combinations without crossing-over.
  - With fertilization and crossing-over,  $(4^{23})^2 = 4,951,760,200,000,000,000,000,000$  combinations are possible.