Cell Division And Heredity

Cell Division

Mitosis

Mitosis is a stage within the cell cycle whereby the parent cells divide into two to produce two identical daughter cells. Each daughter cell results with the same identical genetic information like the original mother as well the fertilised egg in which it originated from. Mitosis is the division of non-sexual cells. It is significant because it takes part in the development of embryos and the growth and progression of bodies. The nucleus divides and imitates the cells unique DNA in six phases outlined below (Greenwood et al ,2019).

- Interphase: This is the preparation stage where the DNA is copied which produces two identical complete sets of chromosomes. Centrosome which have got centrioles inside (which produces spindle) split. (Yourgenome.org, 2016).
- Prophase: The chromosomes pair up and centrioles change their position. The nuclear envelop and the nucleoli decompose and dissolve and this makes the chromosomes to join with spindle fibres randomly (Marieb ,2010)
- Metaphase: The microtubules contain in the chromosome position themselves in a neat line along the metaphase plate whereby chromosomes could be seen in a straight line (Marieb,2015).
- Anaphase: Microtubules places the chromosomes in the centre of the line. The anaphase period finishes when chromosomes stop moving (Yourgenome.org ,2016).
- Telophase: The chromosomes contained in the cells untwist to form chromatin. The spindle decomposes and vanishes, each chromosome mass is enclosed with nuclear envelope whereas the nucleoli is formed within each daughter nuclei (Marieb ,2015).
- Cytokinesis: the formed resources are separated among two new cells before finishing closing off and resulting in two new cells (University of Leicester, no date).

Meiosis

Meiosis is a special type of eukaryotic cell division which forms haploid sex cells or gametes (which have got a single duplicates of chromosome) taken from diploid cells (which have two duplicates of each chromosome). In humans, there is a total of 46 chromosomes, 23 from each parent. Two chromosomes within each pair are said to be homologous chromosomes. An important allowance to homologous chromosomes are the X and Y chromosomes which are not of the same magnitude (size) even if they pair with each other. The X chromosome is said to be lengthier compared to the Y chromosome hence an individual with the XX pairing would be a female and an XY pairing male and the remaining chromosomes are called autosomes (Stonebridge college ,2019).

Meiosis is significant because it is responsible for the creation of sex cells that are accountable for sexual reproduction. This is vital because the number of chromosomes multiply twice after fertilization (Byju’s, no date). Meiosis can be separated into nine phases whereby these could be split among the first cell division (meiosis 1) and the second division (Meiosis II). In many

ways Meiosis is like mitosis and starts with interphase. Meiosis 1 stages incorporates , Prophase 1 ,Metaphase 1 , anaphase 1 , Telophase 1 and Cytokinesis. When the daughter cells are produced each containing 23 chromosomes, they go through Meiosis ll. Stage ll meiosis consists of Prophase ll ,Metaphase ll, Anaphase ll, Telophase ll and Cytokinesis. Once the process of the division of the cytoplasm is complete there is production of 4 new daughter cells, which have a set of half chromosomes each (haploid) (Your Genome, 2016).

Heredity and Variations

Gregor Mendel

Gregor Mendel was an Austrian monk from a small town in Czech republic. Mendel discovered the fundamental principles of heredity through the experimentation of pea nuts found in his gardern. He discovered that the inheritance of characteristics in pea nuts followed a specific arrangement.

There were major reasons for Mendel to choose Pea nuts for his experiment because:

- They grew easily
- They grow rapid
- The traits found in the peas are easy to detect
- Each physical characteristic occurs in different methods.

Mendel discovered and learned seven main traits within the pea plants which came in one or two forms; colour of the flower, position of the colour, length of the stem, shape of the seed , colour of the seed ,shape of the pod and colour of the pod (Stonebridge College ,2019)

Mendel knew that peas reproduce sexually so he transferred pollen by hand from one flower to the other and produced detailed records. Throughout the cross pollination of the yellow and green peas fully, he discovered that the first generation of the offspring yellow in colour (F1). The second generation (F2) had a ratio of 3: 1(Yellow: Green) peas. Mendel found out that the dominant allele hides the recessive one. In relation to the seed colour, the dominant yellow (Y) allele hides the green allele (y) (Khan academy,2019)

Mendel conclusions were as follows:

- Inheritance is determined by genes received by offspring
- Each offspring receives genes from parents
- That physical characteristics might not be present (Stonebridge College,2019)

Mendel discovered that one trait is more dominant than the other through his study of the seven pea plants. He determined 3 key principles:

- The Principle of Segregation- which explains how traits are inherited.
- The Principle of Independent assortment- which explains how two or more qualities are inherited virtual to another.
- The Principle of Dominance- if an organism has got an alternate form of a genes will utilise the dominant one (Khan academy,2019).

Monohybrid and Dihybrid Crosses.

Monohybrid crosses are forms of in heritance through the study of genetic experiments in which two animals or plants can be crossed are genetical undistinguishable apart from a heterozygous gene. Genes are the ones that are passed on and they determine characeristics. The punnet square below can be used to identify inheritance of sex (pearl, 2.2)

Females are said to be homogametic (usually denoted with XX gametes) and males are heterogametic (XY gametes). A sperm would carry 50% Y chromosome and 50 % X chromosome where as the eggs would carry X chromosome. The Sperm containing the X and Y chromosome determines the sex of the foetus. An offspring has got a 50:50 probability or 1.1 ratio of being female or male. Genotype: Phenotype ratio would be 1:1. Genes can be sex linked .The X chromosome is lengthier that Y chromosome which results in males not having a dominant allele of homologous Y chromosome which links conditions like colour blindness, X syndrome and Duchenne's muscular dystrophy (Stonebridge College,2019)

Dihybrid crosses is a cross between two pure organisms of types in order to study the heritage of two pairs of alleles .It results in a di-hybrid ratio of 9:3:3:1 within as well as genotype in the ratio 1:2 1:2 4:2 1:2 within the f2 generation (Stonebridge College 2019).

When two genes are connected, they do not follow the predictable phenotype ratio for a dihybrid cross between heterozygous parents. Therefore, the phenotype will follow that one of a monohybrid as two genes are inherited together which results in offspring parental phenotypes (Bioninja, no date)

Variations and Mutations

Variations are differences within individuals from the parents. Mutations are described as changes in genes. Both of these can have an impact in humans both physically and psychologically. Examples of human variations are eye colour, skin colour and gender. Mutations can occur without knowing due to ionisations, chemical radiations we are exposed to. The changes results in genetic code alterations and cause calls cells to die or cause cells to multiply nonstop (BBC Bitesize.com).

Crossing over is described as biological occurrence that takes place during meiosis when paired homologs, or the same chromosomes are lined up. They are lined up in meiotic plates and have got biological mechanisms which keep the in contact (National Human Research Institute ,2014). There can be changes in the number of chromosomes which promote a condition like Down Syndrome. Down syndrome takes place due to nondisdijention in autosomal cells. People with Down Syndrome have an extra chromosome on autosomal chromosome 21 (pearl.2.3)

Conclusions

Having good insight about Cell Division and Heredity is the golden key in understanding our genetic makeup. Through the works of Gregor Mendel has opened gates for scientists to understand the location of the genes and their composition from one generation to the other. The discovery of Cell division and heredity forms one of the most amazing chapters in biology. Individuals can get a Genetic test, which can identify a faulty gene and diagnose a rare health

condition. Through the understanding of cell division and heredity we get sense of where we are coming from and going.

References

1. A * Biology (2016) Meiosis. [online]. Available at: http://astarbiology.com/cie/676/ (Accessed on 16 January 2016)
2. Bailey, R (2019) Monohybrid Cross: A Genetics Definition. [online].Available at : https://www.thoughtco.com/monohybrid-cross-a-genetics-definition-373473 (Accessed on 18 December 2020)
3. BBC Bitesize (2020) Reproduction, the genome and gene expression. [Online]. Available at: https://www.bbc.co.uk/bitesize/guides/z3mbqhv/revision/8 (Accessed on 20 January 2020)
4. Bear, R. D (2013) Mendel's Experiments .[online].Available at : https://cnx.org/contents/24nI-KJ8@24.18:NjE8d7G4@7/Mendel-s-Experiments (Accessed on 17 January 2020)
5. Bio ninja (No date) Dihybrid crosses.[Online].Available at : http://www.vce.bioninja.com.au/aos-3-heredity/inheritance/dihybrid-crosses.html (Accessed on 18 January 2020)
6. Byju's The Learning App (no date).Significance of Meiosis.[online].Available at: https://byjus.com/biology/significance-of-meiosis/ (Accessed on 16 January 2020).
7. Graves, J (2014) The Conversation .[Online].Available at: https://theconversation.com/sex-genes-the-y-chromosome-and-the-future-of-men-32893 (Accessed on 16 January 2020)
8. Greenwood, T., Smith, L. B., Pryor, K and Allan, R (2013). Cell Biology & Biochemistry: Biology Modular Workbook. [2nd edn]. United Kingdom: Biozone International Ltd
9. Khan Academy (no date). The Law of Segregation. [online].Available at : https://www.khanacademy.org/science/high-school-biology/hs-classical-genetics/hs-introduction-to-heredity/a/the-law-of-segregation (Accessed on 17 January 2020)
10. Marieb, E.N (2015) Essentials of Human Anatomy & Physiology. [11th edn]. England: Person Education Limited.
11. Marieb, E.N (2010) Essentials of Human Anatomy & Physiology. [10th edn]. England: Person Education Limited.
12. National Genome Research Institute (2014) Crossing over. [online].Available at : https://www.genome.gov/genetics-glossary/Crossing-Over (Accessed on 20 January 2020)
13. Stonebridge College (2019) Demonstrate an understanding of heredity and Genetic Variation. [Online]. Available at: https://sac.atomlms.co.uk/pearl-course/1967/ (Accessed on17 January 2020)
14. Stonebridge College (2019) Give a description of Mitosis and Meiosis and discuss their significance .[Online] Available at : https://sac.atomlms.co.uk/pearl-course/1967/ (Accessed on 08 January 2020).
15. Timmer, J (2010) How Mendel started genetics by getting it mostly wrong. [online].Available at: https://arstechnica.com/science/2010/04/breaking-mendels-laws-the-value-of-informative-errors/ (Accessed on 17 January 2020)
16. University of Leicester (no date) The Cell cycle, Mitosis and Meiosis.[Online].Available at: https://www.yourgenome.org/facts/what-is-mitosis (Accessed on 15 January 2019).
17. YourGenome.org (2016) What is Mitosis? [Online].Available at :

https://www.yourgenome.org/facts/what-is-mitosis (Accessed on 08 January 2020)
18. YourGenome.org (2016) What is Meiosis? [Online].Available at: https://www.yourgenome.org/facts/what-is-meiosis (Accessed on 17 January 2020)