

1.4 Introduction of Genetics

What students are to KNOW:

- i. Important of DNA
- ii. Relationships between a cell; nucleus, chromosome, DNA, gene
- iii. Explanation and examples of mitosis, variation, alleles, crosses, selection and evolution

What students are to DO:

- i. State the function of DNA
- ii. Discuss the relationships between a cell, a nucleus, a chromosome, DNA and a gene
- iii. Describe a form of cell division called mitosis
- iv. Explain and give some examples of variation, characteristics, and crosses
- v. Use a Punnett square to work out the results of some simple crosses.
- vi. Discuss evolution and describe the factors affecting it.

DNA (deoxyribonucleic acid); A self-replicating material which is present in nearly all living organisms as the main constituent of chromosomes. It is the carrier of genetic information.

GENE: a unit of heredity which is transferred from a parent to offspring and is held to determine some characteristic of the offspring.

GENOME: the complete set of genes or genetic material present in a cell or organism

CHROMOSOME: a thread-like structure of nucleic acids and protein found in the nucleus of most living cells, carrying genetic information in the form of genes.

GAMETE: a mature haploid male or female germ cell which is able to unite with another of the opposite sex in sexual reproduction to form a zygote

HAPLOID: single set of unpaired chromosomes

INHERIT: derive (a quality, characteristic, or predisposition) genetically from one's parents or ancestors.

ALLELES: -Different form of a gene, each of two or more alternative forms of a gene that arise by mutation and are found at the same place on a chromosome.

DOMINANT: *having power and influence over others.* (a dominant trait or gene)

EVOLUTION: change in a species over time

BREEDING: the mating and production of offspring by animals.

RECESSIVE: relating to or denoting heritable characteristics controlled by genes which are expressed in offspring only when inherited from both parents. (a recessive trait or gene.)

PUNNETT SQUARE: diagram that is used to predict an outcome of a particular cross or breeding experiment.

GENOTYPE: the genetic constitution of an individual organism

PHENOTYPE: the set of observable characteristics of an individual resulting from the interaction of its genotype with the environment

SPECIES: A group of plants or animals that are similar and can interbreed (mate/reproduce)

GENETIC

Important of DNA:

- *the universal blueprint for life on Earth*
- *determines what people look like and how their bodies function*
- *It can cause crippling defects or protect living creatures from disease*
- *It may even determine when it's time to die.*

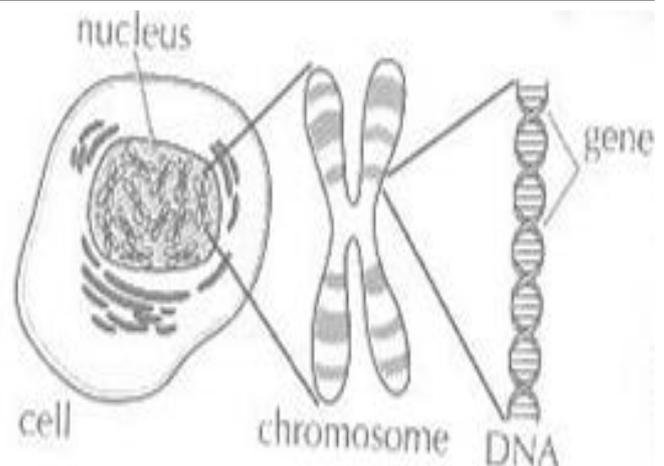
Function of DNA:

- ✓ *Contains the genetic instructions for the development and **function** of living things.*
- ✓ *The main **role of DNA** in the cell is the long-term storage of information.*

Relationship between a cell, a nucleus, a chromosome, DNA and a gene:

- ✓ *Living organisms consists of cells*
- ✓ *Cells contain a nucleus*
- ✓ *The nucleus contains chromosomes*
- ✓ *Chromosomes come in pairs.*

Different numbers of chromosomes in each species (human have 46 chromosomes in the nucleus of each cell (23 pairs))



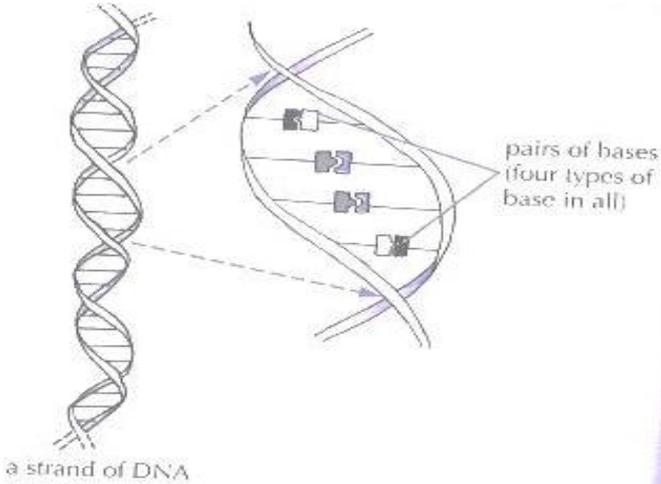
- ✓ Chromosomes are made of coiled DNA
- ✓ Section of DNA form genes.

(the above diagram shows the relationship between a cell, nucleus, chromosome, DNA and genes).

Long form of DNA:

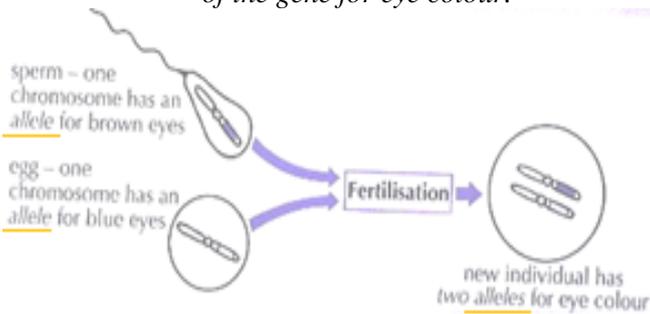
- ✓ Like a ladder that has been twisted.
- ✓ The rungs of the ladder are made up of **bases**.
- ✓ Oder of the bases forms a code that carries instruction for making **protein**

NOTE: order of bases is different in each species; the basic shape of the DNA molecule is the same.



Define alleles: Different form of genes but using a letters (capital or small letter case)

Example: brown eyes and blue eyes are alleles of the gene for eye colour.

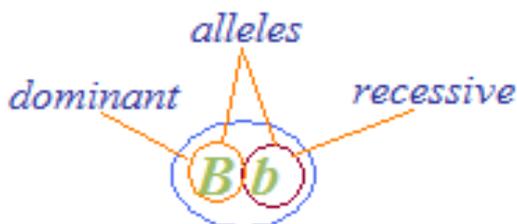


Note: Some alleles are dominant and some are recessive;

Example:

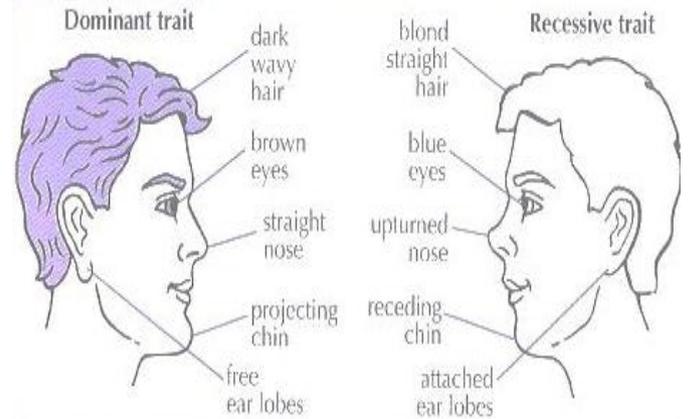
The alleles for browneyes are dominant to the allele for blue eyes.

- ✓ If a person inherits a dominant and a recessive allele, only the dominant allele will 'show up'. The recessive allele is 'hidden'.



- ✓ Allele with the **capital letter is dominant**. From the other hand; alleles with the lower case is **recessive**.

The illustration shows some dominant and recessive traits in human.



Evolution

- Organisms formed in sexual reproduction show variation – they are different from each other and their parents.

-variation of individual within a species is important for the species long-term continuation because it can help certain members of the species to survive if the environment change.

-this is part of evolution

Factors affecting Evolution

1. Competition:

Shortage of resources, food, water, light, space, shelter, mate, members of a species have to compete with each other

Individuals with more favourable **adaptations** survive and breed, passing on the favourable adaptations to their offspring. Other may die.

2. Selection:

-**Variation** means difference. There must be some plants or animals with favourable adaptation if selection is to occur.

-**Selection** is the process of choosing with individual live and reproduces. In natural selection, nature selects which individuals survive to reproduce.

-When there is competition, the best-adapted members of a species survive.

3. Change in the environment:

-can change in various ways such as climate change, change in available food, light, shelter, presence of diseases, predators and so on.

-When the environment changes, different adaptations become the 'best' suited to the new

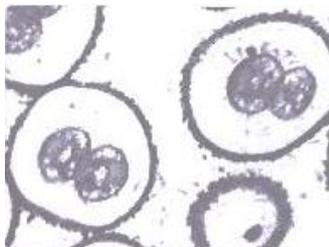
Cell division (MITOSIS):

-cell divide for **growth** and for **tissue repair**: repairing a cut.

-Has been occurring in your body since an egg was fertilised within your mother's fallopian tubes and will continue for the rest of your life.

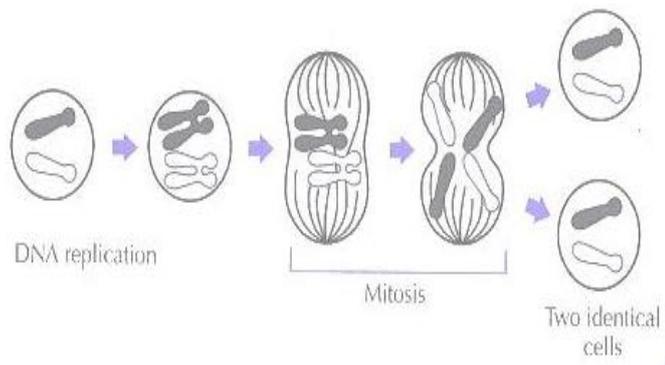
-Before mitosis:

- ✓ the DNA in each chromosome makes a copy of itself.
- ✓ The chromosomes become shorter and thicker and can be seen under a microscope



Chromosomes visible during mitosis in eggs from a worm

- ✓ the chromosomes line up along the middle of the cell, and then come apart at their centres.
- ✓ Each half goes to opposite ends of the cell.
- ✓ A cell membrane form in the middle and two identical cells separate.
- ✓ The initial cells is the 'parent' cell and the resulting two identical cells are 'daughter'

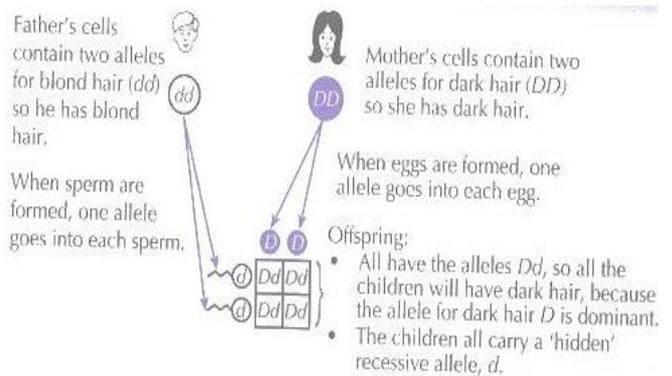


Crosses:

-In genetics, symbols and diagrams are used to work out what traits **offspring** are likely to have.

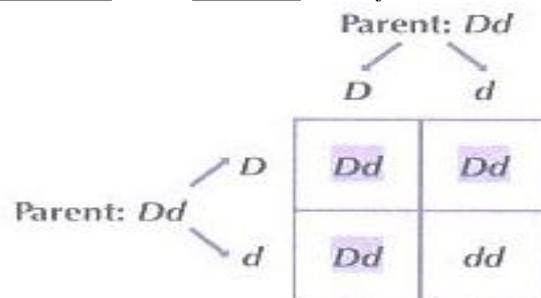
-Letters are used to stand for alleles. A dominant allele is shown by a capital letter, eg: *D*, and a recessive allele is shown by same letter of the alphabet in lower case, eg: *d*.

-Any letter can be used, but it is often the first letter of the dominant allele. Because an individual gets an allele from each parent, that person's genetic formula for a particular characteristic always contains two letters eg: *Dd*



Punnett square:

The following Punnett square shows the possible offspring if each parent is **dark-haired** but has both a **dominant** and a **recessive** allele for hair colour.



Note: Alleles can pair up in 3 different ways: *DD* & *Dd* will produce dark hair, while *dd* will produce blond hair. Blond hair appears in this example because two recessive alleles (*dd*) can come together. But children are three times more likely to have dark hair than blond hair.

There is a 4 dark: 1 blond ratio

25% possibility that a child will have blond hair

Self-Check: 1.3

****Chromosomes, DNA and genes**

1. Copy and label the diagram that shows the relationship between a cell, a nucleus, a chromosome, DNA, and a gene?
2. Why is DNA such an important molecule?
3. a. In what way is DNA similar in all organisms?
b. In what way is DNA different in different species?
4. Name the type of cell division that gives rise to two identical daughter cells from one parent cell.
5. If a parent cell contains 16 chromosomes, how many chromosomes will each daughter cell contain after mitosis?
6. State one place in the human body where mitosis occurs.

****Characteristics**

7. Describe 'variation'
8. Which parts of a chromosome control inherited characteristics?
9. Name two dominant alleles in humans. (from figure 1.1.1)
10. Name two recessive alleles in humans. (from figure 1.1.1)
11. Explain why the children of a woman who has coloured her hair black might not also have black hair.

****Crosses**

12. Explain (in words or pictures) the difference between the following
 - a. Gene and allele
 - b. Dominant allele and recessive allele
13. What are two alleles of the gene for hair colour? (from figure 1.2.1)
14. If B is the allele for brown eyes and b is the allele for blue eyes:
 - a. Which is the dominant allele?
 - b. What colour eyes will a person have if the dominant allele is present?
 - c. If someone has the alleles Bb, what colour are their eyes?
 - d. Which alleles could be passed on to the offspring from the mother if a mother's alleles for eye colour are:
 - i. BB
 - ii. Bb
 - iii. bb
 - e. What will determine her offspring's eye colour if the mother's alleles are Bb and BB?
 - f. Two parents both carry the alleles Bb. Use Punnett square to work out what percentage of their offspring would be expected to have blue eyes.

15. W is the allele for wavy hair and w is the allele for straight hair. A father has the alleles WW, a mother Ww.

- a. What type of hair could their children have?
- b. Draw a Punnett square to work out the answer.

16. Define the following terms (using your own words):

- a. Evolution
 - b. Gene
 - c. Species
 - d. Dominant
 - e. Recessive
 - f. Allele
 - g. variation
 - h. Selection
 - i. mitosis
 - j. Chromosome
-