

## TOPIC 1- GENETICS

## Definition

- Genetics is the study of heredity and variation.
- Heredity is the passing on/ transmission of characteristics/ traits from the parents to the offspring/ young ones.
- Variation refers to observable differences that are seen in organisms of the same species or differences between organisms.
- Species refers to a group of organisms that are able to freely and naturally interbreed to give rise to a viable offspring.
- The offspring show slight differences from their parents. For example in human beings, members of the same family differ in shape of nose, skin colour and height.
- This is because of hereditary factors/ genes each of them acquires from parents and the effect of environment.

## VARIATION.

- This is the differences among organisms of the same species.
- Variations in human beings are shown in tongue rolling, fingerprints, height, and type of earlobes (attached or free), sex, blood groups, skin colour, and weight.
- In plants variations are observed in length of leaves and internodes and size of fruits.

## Types of variation.

- Discontinuous variation.
- Continuous variation.

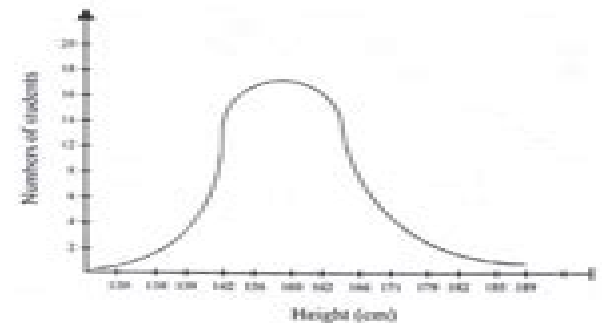
## A. Discontinuous variation

- This is a type of variation where there is a distinct/ definite difference in a given characteristic/ without intermediates.
- It is controlled by genes and the environment has no effect.
- Examples include:
  1. Ability to roll the tongue.
  2. Sex i.e. male or female.
  3. ABO Blood groups/ ABO Blood group system.
  4. Presence of hair in the nose or ear pinna.
  5. Fingerprints.
  6. Free or attached earlobes.
  7. Wing length, size of abdomen, eye color in *Drosophila melanogaster*.
  8. Smooth/wrinkled seed coat, green/yellow color in garden peas.
  9. Melanic/light forms in moths.

## B. Continuous variation.

- This is a type of variation which shows a wide range of differences for the same characteristic/ trait from one extreme end to the other with intermediates.
- It is controlled by both genes and environment.
- Examples include:
  1. Height.
  2. Weight.
  3. Stem diameter.
  4. Skin colour in humans.
  5. Size of seeds and fruits.
  6. Length of fingers in humans.
  7. Milk yield in cows.
  8. Length of leaves.

- For example, when the number of students is plotted against height it gives a **normal distribution curve**.



## Causes of variation

- Gamete formation**—during gamete formation/ meiosis, the following meiotic processes cause variation namely:
  - Crossing over**—exchange of chromatid segments cause new gene combinations which causes variation.
  - Independent assortment**—this is the arrangement of homologous chromosomes at the equator of the spindle during metaphase I.
    - This is followed by segregation/ separation into different daughter cells. The resulting daughter cells/ gametes contain different genetic combination which brings about variation.
- Fertilization**—it allows parental genes to be brought together in different combination.
  - This causes different qualities of parents to be combined differently in the offspring.
- Mutations**—mutation is the spontaneous change in the genetic make-up of an organism. These changes may be inherited by the offspring causing variations.

## Importance of variation

- Organisms/ individuals with advantageous traits/ variations are favored/ selected by nature and survive to pass on the traits to their offspring.
- It ensures propagation of favorable/ advantageous traits to the future generation/ offspring ensuring quality population/ species.

## THE CHROMOSOMES

- They are thread-like structures found in the nuclei of plant and animal cells.
- They contain genetic material called **DNA (Deoxyribonucleic acid)**.
- Each chromosome is made up of two parallel strands called **chromatids**.
- Each pair of chromatids is connected at one point by a structure called **Centromere**.
- In body/ somatic cells each pair of chromosomes has the same length and shape but different versions of the same genes. They are therefore called **homologous chromosomes**.
- During sexual reproduction, each parent contributes one of the chromosomes of the homologous pair.

# Form 4 Genetics

**Sahotra Sarkar**



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*Health Services Reports*, 2001      *Public Health Reports*, 2001      **Genetics** P. K. Gupta, 2007 1 Genetics Epigenetics and Genomics An Overview 2 Mendel's Laws of Inheritance 3 Lethality and Interaction of Genes 4 Genetics of Quantitative Traits QTs 1 Mendelian Approach Multiple Factor Hypothesis 5 Genetics of Quantitative Traits 2 Biometrical Approach 6 Genetics of Quantitative Traits 3 Molecular Markers and QTL Analysis 7 Genetics of Quantitative Traits 4 Linkage Disequilibrium LD and Association Mapping 8 Multiple Alleles and Isoalleles 9 Physical Basis of Heredity 1 The Chromosome Theory of Inheritance 10 Physical Basis of Heredity 2 The Nucleus and the Chromosome 11      **Brenner's Encyclopedia of Genetics** Stanley Maloy, Kelly Hughes, 2013-03-03 The explosion of the field of genetics over the last decade with the new technologies that have stimulated research suggests that a new sort of reference work is needed to keep pace with such a fast moving and interdisciplinary field Brenner's Encyclopedia of Genetics Second Edition Seven Volume Set builds on the foundation of the first edition by addressing many of the key subfields of genetics that were just in their infancy when the first edition was published The currency and accessibility of this foundational content will be unrivalled making this work useful for scientists and non scientists alike Featuring relatively short entries on genetics topics written by experts in that topic Brenner's Encyclopedia of Genetics Second Edition Seven Volume Set provides an effective way to quickly learn about any aspect of genetics from Abortive Transduction to Zygotes Adding to its utility the work provides short entries that briefly define key terms and a guide to additional reading and relevant websites for further study Many of the entries include figures to explain difficult concepts Key terms in related areas such as biochemistry cell and molecular biology are also included and there are entries that describe historical figures in genetics providing insights into their careers and discoveries This 7 volume set represents a 25% expansion from the first edition with over 1600 articles encompassing this burgeoning field Thoroughly up to date with many new topics and subfields covered that were in their infancy or not in existence at the time of the first edition Timely coverage of emergent areas such as epigenetics personalized genomic medicine pharmacogenetics and genetic enhancement technologies Interdisciplinary and global in its outlook as befits the field of genetics Brief articles written by experts in the field which not only discuss define and explain key elements of the field but also provide definition of key terms suggestions for further reading and biographical sketches of the key people in the history of genetics

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genetics and provides the philosophical background necessary to understand the debates over the Human Genome Project It will be of particular interest to professionals and students in the philosophy of science the history of science and the social studies of science medicine and technology *Behavioral Genetics* Ronald A. Carson, Mark A Rothstein, 2003-05-22 Nine essays examining the ethical cultural legal and biological underpinnings of behavioral genetics Scientists conducting human genome research are identifying genetic disorders and traits at an accelerating rate Genetic factors in human behavior appear particularly complex and slow to emerge yet are raising their own set of difficult ethical legal and social issues In *Behavioral Genetics The Clash of Culture and Biology* Ronald Carson and Mark Rothstein bring together well known experts from the fields of genetics ethics neuroscience psychiatry sociology and law to address the cultural legal and biological underpinnings of behavioral genetics The authors discuss a broad range of topics including the ethical questions arising from gene therapy and screening molecular research in psychiatry and the legal ramifications and social consequences of behavioral genetic information Throughout they focus on two basic concerns the quality of the science behind behavioral genetic claims and the need to formulate an appropriate ethically defensible response when the science turns out to be good This book is well written and stimulating The issues it raises are important for scientists and for those working in the legal and social services fields but they clearly also have relevance for everyone The *New England Journal of Medicine* This is the best introduction to behavioral genetics that I have read The varying viewpoints are presented with such clarity that this book should appeal to the general public and serve as a basic text for college courses Jay Katz Elizabeth K Dollard Professor Emeritus of Law Medicine and Psychiatry Harvey L Karp Professorial Lecturer in Law and Psychoanalysis Yale Law School

Genetics of Inborn Errors of Metabolism Elsayed Abdelkreem, Sunita Bijarnia-Mahay, 2023-10-27 **The Practical Guide to the Genetic Family History** Robin L. Bennett, 2011-09-20 HELPS YOU DEVELOP AND ASSESS PEDIGREES TO MAKE DIAGNOSES EVALUATE RISK AND COUNSEL PATIENTS The Second Edition of *The Practical Guide to the Genetic Family History* not only shows how to take a medical family history and record a pedigree but also explains why each bit of information gathered is important It provides essential support in diagnosing conditions with a genetic component Moreover it aids in recommending genetic testing referring patients for genetic counseling determining patterns of inheritance calculating risk of disease making decisions for medical management and surveillance and informing and educating patients Based on the author's twenty five years as a genetic counselor the book also helps readers deal with the psychological social cultural and ethical problems that arise in gathering a medical family history and sharing findings with patients Featuring a new Foreword by Arno Motulsky widely recognized as the founder of medical genetics and completely updated to reflect the most recent findings in genetic medicine this Second Edition presents the latest information and methods for preparing and assessing a pedigree including Value and utility of a thorough medical family history Directed questions to ask when developing a medical family history for specific disease conditions Use of pedigrees to identify individuals with an increased

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aspects of healthcare and particularly in the field of cancer care Genetics for Health Professionals in Cancer Care From Principles to Practice equips health professionals with the knowledge and skills required for all aspects of managing cancer family history This includes taking an accurate cancer family history and drawing a family tree understanding cancer biology basic cancer genetics and the genes involved in hereditary breast ovarian prostate colorectal gastric and related gynaecological cancers and rare cancer predisposing syndromes assessing cancer risk and communicating risk information early detection and risk reducing measures available for those at increased risk and managing individuals with hereditary cancer Drawing on experiences of health professionals Genetics for Health Professionals in Cancer Care discusses the challenges raised and provides practical advice and insight into what happens when a patient is referred for genetic counselling and genetic testing including the psychological social and ethical issues faced by individuals and families with and at risk of hereditary cancer The book also provides practical guidance on setting up a cancer family history clinic in primary and secondary care Genetics for Health Professionals in Cancer Care is essential reading for healthcare professionals working with cancer patients and their families and is an ideal reference text for non specialists working in cancer genetics

**Soybean Genetics Newsletter** ,1996

**Genetic Counseling for Adult Neurogenetic Disease** Jill S. Goldman,2014-12-01 The adult patient diagnosed with or at risk for a neurogenetic disease has many questions and concerns for the genetic counselor the neurologist and other practitioners Because of the emotional and potentially life altering impact of these diseases on the patient and family counseling can be especially challenging A rare hands on guide to the subject Genetic Counseling for Adult Neurogenetic Disease deals with core issues that differentiate adult neurogenetic counseling from its more familiar pediatric counterpart This innovative book with accompanying videos is designed to fill in deficits in this area typical of training programs in genetic counseling which have pediatrics and prenatal concentrations and neurology which rarely cover genetic counseling For each condition featured chapters include a detailed overview of genetic symptoms diagnostic criteria and management plus guidelines for asking and answering pertinent questions The major concentration however is on genetic counseling issues and case histories illustrating these issues As an added dimension the accompanying videos depict representative issues and challenges in genetic counseling for specific diseases in addition to the basics of a neurological examination Among the conditions discussed Movement disorders including Parkinson s disease Dementias including Alzheimer s disease Stroke Motor neuron diseases Neuropathies and channelopathies Adult muscular dystrophies Neurocutaneous syndromes Plus a section on neurological and neuropsychological evaluation This is information that will stay relevant as technologies change and genetic understanding evolves Genetic Counseling for Adult Neurogenetic Disease offers advanced clinical wisdom for genetic counselors as well as neurologists neuropsychologists and other referring clinicians

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