

A Few Words about Modern Genetics

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Abstract

The human organism is composed of cells that have their own building blocks, among which the most important role is played by the nucleus, which contains the genetic material that we inherit from our parents, and which carries information about the way the human organism should function. This genetic material is found on DNA molecules, and DNA molecules are packaged in the form of chromosomes, which are formed by wrapping DNA molecules around proteins.

Hereditary diseases are caused by mutations of one or more genes, which we inherited from one or both parents. Hereditary diseases are not the same as genetic diseases because some mutations and gene damage can occur after fertilization and later in a person's life. Some genetic defects can be manifested by congenital malformations or diseases, but the defects of some genes will lead to disease symptoms only in adulthood or only under the influence of environmental factors. Through research in the field of molecular biology, the method of analyzing genetic markers is continuously improved, the sensitivity threshold of the method is lowered, and thus the analysis of increasingly scarce biological samples is enabled. The ultimate goal of biological expertise is to establish the identity of the person from whom the disputed trace originates, and for this purpose, the DNA profile of the disputed trace is compared with the DNA profile of an undisputed sample of the person. Non-disputable samples are blood samples or samples of oral cavity epithelium that are taken from a person of known identity. The match of the DNA profile of the disputed trace with the DNA profile of the undisputed sample confirms that the disputed trace originates from a certain person.

Keywords: genetics; DNA; genetic diseases; forensics

Introduction

Some of the maximum critical latest discoveries approximately conduct contain genetics [1]. For instance, autism is a extreme ailment starting early in youth wherein youngsters withdraw socially, now no longer undertaking eye touch or physical touch, with marked conversation deficits and stereotyped conduct. Until the 1980s, autism become concept to be environmentally due to cold, rejecting dad and mom or with the aid of using mind damage. But genetic research evaluating the danger for same twins, who're same genetically (like clones), and fraternal twins, who're most effective 50 percentage comparable genetically, imply vast genetic influence. If one member of an same dual pair is autistic, the danger that the opposite dual is additionally autistic may be very high, approximately 60 percentage. In contrast, for fraternal twins, the danger is low. Molecular genetic research try to become aware of the genes that make contributions to the genetic susceptibility to autism.

Later in youth, a very not unusualplace concern, mainly in boys, is a cluster of interest-deficit and disruptive conduct troubles known as interest-deficit/hyperactivity ailment (ADHD). Results received from severa dual research have proven that ADHD is surprisingly heritable (genetically influenced). ADHD is one of the first behavioral regions wherein specific genes had been identified. Although many different regions of youth psychopathology display genetic influence, none are as heritable as autism and ADHD. Some conduct troubles, which include youth tension and

depression, are most effective fairly heritable, and others, which include antisocial conduct in adolescence, display little genetic influence.

Gene

What is a gene isn't always such an clean question; at the contrary, it's far a philosophical question [2]. One of the maximum critical findings of molecular genetics is that the concept of a gene as a easy causal agent isn't always valid. The series of DNA this is referred to as a 'gene' has that means most effective inside a particular context, which determines its expression and characteristic. That is why a single gene can also additionally have distinct effects relying at the context wherein it's far placed (cell context, environmental context, character context, etc.). The human genome has approximately 21,000 genes and over three billion nitrogen base pairs, however observe that of those three billion base pairs, most effective five% are encoding areas, i.e. codify for proteins. The last 95% was once known as till the early 2000s 'junk DNA', however it's far now recognized that the time period become a misnomer and is thought that it performs a essential physiological function, mainly in regulating the price of gene expression. It is envisioned that most effective 0.1% of the genome varies among people of the human species. A gene is commonly taken into consideration to be a particular place of the genome whose DNA series encodes for a discrete organic entity, commonly a protein, however as we are able to repeat frequently for the duration of this volume, genes aren't the most effective approach of inheritance withinside the human species. There are at least 3

different ranges that decide the inheritance of tendencies: the epigenetic level (methylation and different adjustments at the DNA that have an effect on its characteristic and expression and are handed right all the way down to destiny generations); and the behavioural and symbolic inheritance system, which collectively shape what we commonly check with as 'culture'.

By 'genome', we refer to the whole genetic fabric this is transmitted to the subsequent generation. In the human species, it's far for the maximum element encoded withinside the DNA series contained withinside the nucleus, even though we've got a small range of genes withinside the mitochondria organelles, which if mutated are answerable for a few varieties of neurodegenerative illnesses.

Chromosomes are nothing aside from discrete, compact devices of the genome wherein DNA molecules are organised and that deliver many genes. The human species has 23 pairs of chromosomes (every chromosome of the identical pair is known as homologous), which emerge as unpacked at some point of cell department. There are fundamental varieties of cell department: meiosis, the cell department which takes vicinity at some point of sexual reproduction, and mitosis, the regular form of cell department. With the word 'karyotype' we check with the whole chromosomal supplement of a cellular or species, withinside the case of the human species, 23 pairs, XX for women, XY for men. A karyotypic evaluation is generally done at some point of prenatal screening to set up the absence of chromosomal issues, of which the maximum not unusualplace is trisomy 21 or Down Syndrome (wherein there are 3 in place of copies of chromosome 21)

Each gene can arise in numerous viable forms, recognised as 'alleles'. In human beings, there generally are alleles for every gene, one in every of that's placed on every chromosome and one in every of that's inherited from every parent. For every gene, an character may be homozygous, that means having same alleles (both of the maximum not unusualplace variation reproduction of the gene, or of the much less not unusualplace reproduction of the gene), or heterozygous, that means having one allele of the maximum not unusualplace reproduction and the opposite of the much less not unusualplace reproduction of the gene. Individuals are stated to be heterozygous after they have distinct alleles at a selected locus, and homozygous whilst they've the identical allele at corresponding loci at the homologous chromosome.

Genomics

A not unusualplace misconception withinside the scientific network is that genetic issues include a group of extraordinarily uncommon situations which can be seldom applicable to everyday medical exercise [3]. In reality, basically each scientific circumstance affecting humankind has as a minimum a few genetic factor to its etiology. The take a look at of the way mutations in single genes reason uncommon disorder (genetics) is steadily being eclipsed with the aid of using studies on how mutations in more than one genes engage with every different and the surroundings to bring about health and disease (genomics). Knowledge derived from genomic discoveries is reshaping the underpinnings of tons of scientific exercise, and could retain to accomplish that for many years to come. At a sensible level, latest advances have taught us a brilliant quantity approximately the idea of not unusualplace situations which include diabetes, heart disorder, and cancer. This new expertise is being unexpectedly translated into processes for disorder danger assessment, prevention, and remedy. Likewise, the take a look at of the way genes have an effect on drug metabolism (pharmacogenetics) is being more and more more used to tell drug prescribing. Importantly, primary care physicians need to now no longer lose sight of the reality that so-known as uncommon single-gene issues together constitute a extensive percentage of pediatric and grownup illnesses.

Primary care physicians are in a completely unique role to diagnose genetic issues due to the fact they're frequently the primary touch for sufferers and additionally offer take care of more than one own circle of relatives members. Recognition of, and next interest to, the presence of genetic danger elements for disorder in an character may be lifesaving for people and their relatives. Further, as pharmacogenetics will become more and more more

critical to drug remedy, primary care providers will want to be aware about and comfortable with ordering and deciphering this form of checking out previous to prescribing a style of medications.

Genetic Disease

The conventional diagnostic technique to genetic disease, primarily based totally at the ideas of classic genetics, is directed in the direction of first figuring out the abnormality withinside the patient; then figuring out the gene product (most customarily a protein) this is answerable for the disease, which include an bizarre hemoglobin or an enzyme deficiency; and sooner or later, trying to become aware of the gene answerable for the bizarre gene product that brought about the cellular dysfunction [4]. More recently, because of a higher knowledge of the series of DNA that constitutes the regular genome, there was a shift in the direction of molecular genetics processes. Often the approach is to look for institutions among the disease trait and different properly-described DNA markers that modify in populations (polymorphisms). Such polymorphisms arise for the duration of the whole human genome and function landmarks for such research. For instance, consider that there's a polymorphism in a DNA series inside or close to a gene for a hemoglobin that has detectable forms:

A and B. If within families the presence of an unknown disease trait follows that of the marker (segregates with the marker) such that everybody withinside the own circle of relatives who has the disorder additionally has marker A or B, it's far in all likelihood that the gene for the unknown disease is placed close to (or possibly includes) the marker. If we recognize wherein the marker is placed withinside the genome (in this situation hemoglobin), we then recognize that the gene for the brand new disorder is close to the gene for hemoglobin. The tendency for genes (or maybe noncoding segments of DNA) bodily near in the genome to transport collectively (i.e., to be inherited collectively) is named linkage. Many complicated statistical processes are to be had for investigating those institutions in lots of households or even in huge companies of unrelated people (genomewide association studies [GWAS]). Having diagnosed the place of the mutation, the human genetic map is searched to decide what genes are placed at that role. One can than series such genes from people with the disease to decide how they fluctuate from the regular gene, then decide the manufactured from the gene, and sooner or later examine how the bizarre gene and its gene product disrupt the features of the cellular.

Alzheimer Disease

One of the greatest genetic achievement tales entails the maximum not unusualplace behavioral ailment in later existence, the horrible reminiscence loss and confusion of Alzheimer disease, which moves as many as one in five people of their eighties [1]. Although Alzheimer disease not often takes place earlier than the age of sixty five, a few early-onset instances of dementia run in households in a easy way that indicates the influence of single genes. Three genes had been discovered to be answerable for a lot of those uncommon early-onset instances.

These genes for early-onset Alzheimer disorder aren't answerable for the tons greater not unusualplace shape of Alzheimer disease that takes place after sixty five years of age. Like maximum behavioral issues, late-onset Alzheimer disorder isn't always due to only a few genes. Still, dual research imply genetic influence. If you've got a dual who has lateonset Alzheimer disorder, your danger of growing it's far two times as awesome if you're an same dual in place of a fraternal dual. These findings suggest genetic influence.

Even for complicated issues like late-onset Alzheimer disease, it's far now viable to become aware of genes that make contributions to the danger for the ailment. For instance, a gene has been identified that predicts danger for late-onset Alzheimer disease some distance higher than some other recognised danger factor. If you inherit one reproduction of a selected shape (allele) of the gene, your danger for Alzheimer disease is set 4 times extra than when you have any other allele. If you inherit copies of this allele (one from every of your dad and mom), your danger is tons extra. Finding those

genes for early-onset and late-onset Alzheimer disease has greatly improved our knowledge of the mind techniques that cause dementia.

Intellectual Disability

Another instance of latest genetic discoveries entails highbrow incapacity [1]. The single maximum critical reason of highbrow incapacity is the inheritance of a whole more chromosome 21. (Our DNA, the simple hereditary molecule, is packaged as 23 pairs of chromosomes. Instead of inheriting most effective one pair of chromosomes 21, one from the mother and one from the father, a whole more chromosome is inherited, commonly from the mother. Often known as Down syndrome, trisomy-21 is one of the important motives why ladies fear approximately being pregnant later in existence. Down syndrome takes place tons greater often whilst mothers are over forty years vintage. The more chromosome may be detected early in being pregnant with the aid of using a whole lot of procedures, which include amniocentesis, chorionic villus sampling, and more moderen noninvasive techniques that have a look at fetal DNA withinside the maternal bloodstream.

Another gene has been identified this is the second one maximum not unusualplace reason of highbrow incapacity, known as fragile X syndrome. The gene that reasons the ailment is on the X chromosome. Fragile X syndrome takes place almost two times as frequently in men as in girls due to the fact men have most effective one X chromosome. If a boy has the delicate X allele on his X chromosome, he'll broaden the ailment. Females have X chromosomes, and it's far essential to inherit the delicate X allele on each X chromosomes that allows you to broaden the ailment. However, girls with one fragile X allele also can be affected to a few extent. The fragile X gene is mainly thrilling as it entails a form of genetic disorder wherein a short series of DNA mistakenly repeats masses of times. This form of genetic disorder is now additionally recognised to be answerable for numerous different previously difficult illnesses.

Research

Genetic studies on conduct is going past simply demonstrating the significance of genetics to the behavioral sciences and permits us to invite questions on how genes influence conduct [1]. For instance, does genetic influence extrade at some point of improvement? Consider cognitive cappotential, for instance; you may suppose that as time is going with the aid of using we more and more collect the effects of Shakespeare's "slings and arrows of outrageous fortune." That is, environmental differences may emerge as more and more more critical at some point of one's existence span, while genetic differences may emerge as much less critical. However, genetic studies indicates simply the opposite: Genetic influence on cognitive cappotential will increase for the duration of the character's existence span, attaining ranges later in existence which can be almost as awesome as the genetic influence on height. This finding is an instance of developmental behavioral genetic studies.

Genetic studies is likewise converting the manner we reflect on consideration on surroundings. For instance, we used to suppose that developing up withinside the identical own circle of relatives makes brothers and sisters comparable psychologically. However, for maximum behavioral dimensions and issues, it's far genetics that debts for similarity amongst siblings. Although the surroundings is critical, environmental influences could make siblings developing up withinside the identical own circle of relatives different, now no longer comparable. This genetic studies has fostered environmental studies seeking out the environmental motives why siblings withinside the identical own circle of relatives are so different.

Recent genetic studies has additionally proven a shocking end result that emphasizes the want to take genetics into consideration whilst analyzing surroundings: Many environmental measures used withinside the behavioral sciences display genetic influence! For instance, studies in developmental psychology frequently entails measures of parenting that are, moderately enough, assumed to be measures of the own circle of relatives surroundings. However, genetic studies has convincingly proven genetic influence on parenting measures. How can this be? One manner is that genetic differences

amongst dad and mom influence their conduct in the direction of their youngsters. Genetic differences amongst youngsters also can make a contribution. For instance, dad and mom who've more books of their home have youngsters who do higher in school, however this correlation does now no longer always imply that having greater books withinside the home is an environmental reason for youngsters appearing properly in school. Genetic elements may want to affect parental tendencies that relate each to the range of books dad and mom have of their home and to their youngsters's success at school. Genetic involvement has additionally been discovered for plenty different ostensible measures of the surroundings, which include youth accidents, existence events, and social support. To a few extent, humans create their personal studies for genetic motives.

Genetic Manipulation

The use of genetics and genetic manipulation with the aid of using human beings for the remedy of human disorder is a brand new and unexpectedly evolving subject of each simple technological know-how and medical remedy [5]. The technological know-how of gene remedy is derived from extensive studies advances withinside the fields of genetics, molecular biology, medical remedy, and human genomics. Thus, gene remedy may be described as using genetic manipulation for remedy of disorder. Experimental gene remedy studies breakthroughs located in version structures are changed for medical or bedside use, forming the rising exercise of molecular remedy. Molecular remedy encompasses the elucidation of the genetic foundation of disorder, analysis of the disorder, the layout of the perfect technique to disorder control or remedy, the software of permitted healing protocols, and tracking of medical outcomes.

In the records of the exercise of western remedy, preliminary standards of disorder have been associated with an imbalance withinside the personality or humus. Illness become handled on a wholebody or systemic level. As the exercise of medication superior to and via the 20th century, greater records have become to be had concerning the body structure of the frame in addition to its organ and tissue structure. Subsequently, advances have been made into the cell biology of health and disease. Most recently, studies investigations opened perception into the genetic foundation of inheritance and the organic techniques on the molecular level. These have been particularly withinside the genetics and molecular biology of selective breeding practices for flora and animals. The simple ideas shape a nidus for experimental remedies for human illnesses.

The bases for this software to human disorder are the a success improvement of the scientific and surgical strategies in human organ transplantation, the western culture of pharmacotherapy, and the persevering with elucidation of the human genome and its regulatory elements. On what appears to be an nearly day by day foundation, startling new molecular genetic discoveries are publicized. Some have profound ethical and moral considerations, which include the cloning of sheep and primates. Others cause a profound knowledge of the pathogenesis of human disorder, which include the identity of the mutation withinside the genes answerable for liver illnesses, which include, hemochromatosis or, in pediatrics, Alagille syndrome. The cloning research display us the brand new frontiers of genetic remedy and project us to apply them wisely. The discoveries of mutant genes main to disorder pathology lend the promise of fast analysis and probably early medical intervention taking into consideration higher scientific control. However, the discoveries of genes answerable for human pathology project us withinside the use of genetic population screening. The evolving subject of genetic epidemiology can offer particular dana at the occurrence and occurrence of a particular inherited trait. The project right here is to apply this records ethically and in a medically useful way.

The essential concept at the back of gene remedy appears nearly too clean: simply update an altered (mutant) gene with the corresponding regular (wildtype) gene [6]. In theory, whilst a disorder is due to a single gene mutation it need to be truthful to deal with the disorder with a wildtype gene. The defective, mutant gene withinside the patient's cells can probably be rescued with the aid of using introducing the wildtype gene, which makes the useful wildtype proteins that characteristic nicely withinside the cells.

The cappelotential to plot a success gene remedy strategy relies upon on understanding the identification of the mutant gene that reasons the disorder. The scientists should find out about the precise gene expression styles and biochemical techniques withinside the wholesome and disorder cells that allows you to layout the high-quality technique for the gene remedy remedy, which include the high-quality manner to deliver the healing wildtype gene to the goal cells withinside the frame.

Forensic Genetics

The improvement and alertness of genetics has revolutionized forensic technological know-how [7]. In 1984, the evaluation of polymorphic areas of DNA produced what become termed 'a DNA fingerprint'. The following year, on the request of the United Kingdom Home Office, DNA profiling become efficaciously carried out to casework whilst it become used to clear up an immigration dispute. In 1986, DNA proof become used for the first time in a criminal case concerning the murder of young women in Leicestershire, UK: DNA evaluation exonerated one individual who had confessed to one of the murders, and following a mass display screen of about 5000 people.

Following on from early achievement in each civil and crook instances, using genetics become unexpectedly followed with the aid of using the forensic network and now performs an critical function global in each the research of crime and in dating checking out. The scope and scale of DNA evaluation in forensic technological know-how is about to retain increasing for the foreseeable destiny.

The work of the forensic geneticist will range broadly relying at the laboratory and us of a that they paintings in, and might contain the evaluation of fabric recovered from a scene of crime, kinship checking out and the identity of human remains. In a few instances, it could also be used for the evaluation of DNA from flora; animals which include insects; and microorganisms.

Forensic laboratories acquire fabric that has been recovered from scenes of crime, and reference samples from each suspects and victims. The function of forensic genetics withinside the investigative procedure is to examine samples recovered from crime scenes with suspects and probably victims, ensuing in a file that may be provided in courtroom docket or intelligence which can tell an research.

DNA

Gene remedy gives the cappelotential of a one-time treatment for devastating inherited issues [6]. It has application to many illnesses for which current healing processes are useless or wherein the potentialities for effective remedy are obscure. Current recombinant deoxyribonucleic acid (DNA) technology permit for the fast identity of genes and the facile manipulation of genetic material. This permits scientific researchers to have a look at cell body structure at a molecular level. Using those tools, scientists and clinicians can become aware of and decide a molecular basis of disease. There is a huge array of illnesses wherein precise protocols of gene remedy may want to offer novel healing processes. These are the "conventional genetic illnesses" so known as for his or her familiarity in medical remedy. They include chromosomal issues which can be inherited as a single gene, Mendelian ailment (autosomal dominant, autosomal recessive, sex-linked recessive, or sex-linked dominant), and end result from a mutation at a single locus. These examine to the multifactorially inherited issues that contain more than one genes operating in live performance with recognised or enigmatic environmental elements.

Each person's genome includes a huge quantity of DNA that may be a cappelotential goal for DNA profiling [4]. The choice of the precise place of polymorphic DNA to examine can extrade with the character case and additionally the era this is to be had.

DNA has frequently been defined as the 'blueprint of existence', containing all of the records that an organism calls for that allows you to characteristic and reproduce. The DNA molecule that incorporates out the sort of essential organic function is extraordinarily easy. The simple constructing block of the

DNA molecule is the nucleotide triphosphate. This incorporates a triphosphate group, a deoxyribose sugar and one in every of 4 bases.

The records withinside the DNA 'blueprint' is coded with the aid of using the series of the 4 distinct nitrogenous bases, adenine, guanine, thymine and cytosine, on the sugar-phosphate backbone.

Human Genome

The DNA molecule is the idea of the human genome [8]. The double-helix is formed with the aid of using a backbone of sugars which can be connected with the aid of using paired bases. The pyrine bases (adenine (A) and guanine (G)) have carbon-nitrogen rings, while the pyrimidine bases (cytosine (C), and thymine (T)) have most effective one such ring. The pairing of the bases is complementary—this is, cytosine will most effective bind to guanine, and thymine to adenine. This approach that the series of bases alongside the single strand may be replicated with the aid of using binding every base to its complementary base. Hydrogen bonds exist among the bases to stabilize the pairing.

Each monomer withinside the chain of polymers is known as a nucleotide and incorporates a sugar, a base, and a phosphate group. The order of the bases in a single strand of DNA offers the template for single-stranded ribonucleic acid, which offers the code for the formation of the polypeptide or amino acid. Each amino acid is coded for with the aid of using a series of 3 bases (a codon). Note that thymine is replaced with the aid of using uracil in RNA.

PCR

PCR (polymerase chain reaction) can enlarge a particular place of DNA with the aid of using copying the locus exponentially [7]. The approach has revolutionized all regions of molecular biology, which include forensic genetics, as extraordinarily small portions of DNA can be analysed. Under most excellent situations, DNA may be amplified from a single cellular. The improved sensitivity of DNA profiling the use of PCR has had a dramatic effect at the varieties of forensic pattern that may be used, and it's far now viable to examine hint proof and surprisingly degraded samples efficaciously – albeit with much less than 100% achievement.

PCR era become unexpectedly included into forensic evaluation. The first PCR-primarily based totally device for forensic casework amplified the polymorphic HLA-DQ α locus (the α subunit of the DQ protein is a part of the important histocompatibility complicated). It become used for the primary time in casework in 1988 to examine the skeletal remains of a three-year-vintage girl. The DQ α system's important downside become that it had a constrained strength of discrimination.

Minisatellites (VNTRs) have been broadly utilized in casework however required a extraordinarily huge quantity of DNA. In an strive to triumph over this limitation, PCR era become carried out to the evaluation of VNTR loci, and alleles among 5 kb and 10 kb may want to be faithfully amplified from sparkling organic fabric. However, it become of constrained price for plenty forensic samples, which frequently contained small quantities of DNA that become surprisingly degraded. To conquer the troubles due to degradation, tandem repeats, known as amplified fragment duration polymorphisms (AMP-FLPs) that have been smaller than 1 kb have been decided on for PCR primarily based totally evaluation. However, as with VNTRs, their use become constrained in forensic contexts due to the scale of the large alleles, which have been hard to examine in degraded samples.

Conclusion

Expertise on traces of human origin involves the application of various methods, the most important of which is the method of molecular genetic analysis, which enables the identification of the person from whom the trace originates. Analysis of the structure of the DNA molecule, i.e. the difference in the sequence and number of repetitions of its building units - nucleotide bases, gives a DNA profile unique to each person and is the basis of the application of molecular genetics in forensics. The method of molecular genetic analysis begins with the extraction of DNA molecules from cells with

the aim of removing molecules and impurities from the sample that would negatively affect further analysis. The amount of DNA in the sample and the quality of the sample, i.e. the degree of DNA degradation, is determined by polymerase chain reaction in real time. From samples with a sufficient concentration of DNA, using the polymerase chain reaction method, the targeted DNA sequences are amplified in billions of copies, which makes it possible to determine the DNA profile even from very scarce samples.

References

1. Knopik, V. S.; Neiderhiser, J. M.; DeFries, J. C.; Plomin, R. (2017.): „Behavioral Genetics, Seventh Edition”, Worth Publishers, Macmillan Learning, New York, USA, pp. 1-4.
2. Camporesi, S.; McNamee, M. (2018.): „Bioethics, Genetics and Sport”, Routledge, Taylor & Francis Group, Abingdon, UK, pp. 4-5.
3. Hogge, W. A. (2015.): „Genetics for Family Physicians” in South-Paul, J. E.; Matheny, S. C.; Lewis, E. L. (eds): „CURRENT Diagnosis & Treatment in Family Medicine, Fourth Edition”, McGraw-Hill Education, New York, USA, pp. 512.
4. Reisner, E. G.; Reisner, H. M. (2017.): „Crowley's An Introduction To Human Disease - Pathology and Pathophysiology Correlations, Tenth Edition”, Jones & Bartlett Learning, LLC, Burlington, USA, pp. 83.
5. Kresina, T. F.; Branch, A. D. (2001.): „Molecular Medicine and Gene Therapy: An Introduction” in Kresina, T. F. (ed): „An Introduction to Molecular Medicine and Gene Therapy”, Wiley-Liss, Inc., John Wiley & Sons, Inc., New York, USA, pp. 1-2.
6. Fitzgerald-Hayes, M.; Reichsman, F. (2010.): „DNA And Biotechnology, Third Edition”, Academic Press, Elsevier, Burlington, USA, pp. 244.
7. Goodwin, W.; Linacre, A.; Hadi, S. (2011.): „An Introduction to Forensic Genetics, Second Edition”, Wiley-Blackwell, John Wiley & Sons, Chichester, UK, pp. 1. - 2., 11., 53-54.
8. Skirton, H.; Patch, C.; Williams, J. (2005.): „Applied Genetics in Healthcare - A Handbook for Specialist Practitioners”, Taylor & Francis Group, New York, USA, pp. 11.

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