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Editorial: Methods for studying the genetics, molecular biology, physiology, and pathogenesis of the streptococci Paula Fives-Taylor & Donald J. DeBlanc vii-ix.

Tn transponson mutagenesis and marker rescue of interrupted genes of Streptococcus mutans; D. Site-specific homologous recombination mutagenesis in group B streptococci; H. Targeted mutagenesis of enterococcal genes; X. A lactococcal pWVbased integration toolbox for bacteria; K. Vectors containing streptococcal bacteriophage integrases for site-specific gene insertion; W. Streptococcal integration vectors for gene inactivation and cloning; Lin Tao. Induction of transformation in streptococci by synthetic competence stimulating peptides; P. Use of electroportation in genetic analysis of enterococcal virulence; H. Genetic transfer methods for Streptococcus sobrinus and other oral streptococci; D. Isolation of enterococcal antigen-encoding genes from genomic libraries; Yi Xu, et al. A simple microtiter plate screening assay for bacterial invasion or adherence; V. A non-radioactive approach to mapping transponson insertions; M. A method for mapping phage-inducible promotors for use in bacteriophage-triggered defense systems; G. Secretion of heterologous proteins by genetically engineered Streptococcus gordonii; T. Examination of streptococcal gene expression in the mammalian environment; W. Analysis of adherence-associated gene expression in Streptococcus parasangusis: A method for RNA isolation; E. Development of an integrative, lacZ transcriptional-fusion plasmid vector for Streptococcus mutans and its use to isolate expressed genes; F. Use of proteomics and PCR to elucidate changes in protein expression in oral streptococci; R. Quivey Jr, et al. The use of continuous flow bioreactors to explore gene expression and physiology of suspended and adherent populations of oral streptococci; R. In vitro systems for investigating group B streptococcal: The rat model of endocarditis; C. Lipoproteins and other cell-surface associated proteins in streptococci; R. Growth of Streptococcal mutans in an iron-limiting medium; G. Identification of oral streptococci using PCR-based, reverse-capture, checkerboard hybridization; B. Pulsed-field gel electrophoresis as an epidemiologic tool for enterococci and streptococci; J. Cell-based panning as a means to isolate phage display Fabs specific for a bacterial surface protein; A.

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Chapter 2 : Biomedical Studies & Molecular Biology Â· College of the Atlantic

Molecular genetics is the study of the molecular structure of DNA, its cellular activities (including its replication), and its influence in determining the overall makeup of an organism. Molecular genetics relies heavily on genetic engineering (recombinant DNA technology), which can be used to.

Forward genetics This technique is used to identify which genes or genetic mutations produce a certain phenotype. A mutagen is very often used to accelerate this process. Once mutants have been isolated, the mutated genes can be molecularly identified. This type of genetic screening is used to find and identify all the genes involved in a trait. Reverse genetics Reverse genetics determines the phenotype that results from a specifically engineered gene. In other words this process involves the creation of transgenic organisms that do not express a gene of interest. Alternative methods of reverse genetic research include the random induction of DNA deletions and subsequent selection for deletions in a gene of interest, as well as the application of RNA interference. Gene therapy A mutation in a gene can cause encoded proteins and the cells that rely on those proteins to malfunction. Conditions related to gene mutations are called genetic disorders. Gene therapy can be used to replace a mutated gene with the correct copy of the gene, to inactivate or knockout the expression of a malfunctioning gene, or to introduce a foreign gene to the body to help fight disease. Gene therapy is an appealing alternative to some drug-based approaches, because gene therapy repairs the underlying genetic defect using the patients own cells with minimal side effects. All experiments and products are controlled by the U. There are several different physicochemical and biological methods that can be used to transfer genes into human cells. The size of the DNA fragments that can be transferred is very limited, and often the transferred gene is not a conventional gene. Horizontal gene transfer is the transfer of genetic material from one cell to another that is not its offspring. Artificial horizontal gene transfer is a form of genetic engineering. However, because of technological advances the progress of the project was advanced and the project finished in , taking only thirteen years. The project was started by the U. Department of Energy and the National Institutes of Health in an effort to reach six set goals. The collaborative effort resulted in the discovery of the many benefits of molecular genetics. Discoveries such as molecular medicine, new energy sources and environmental applications, DNA forensics, and livestock breeding, are only a few of the benefits that molecular genetics can provide.

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Methods in genetics Experimental breeding Genetically diverse lines of organisms can be crossed in such a way to produce different combinations of alleles in one line. For example, parental lines are crossed, producing an F1 generation, which is then allowed to undergo random mating to produce offspring that have purebreeding genotypes i. This type of experimental breeding is the origin of new plant and animal lines, which are an important part of making laboratory stocks for basic research. When applied to commerce, transgenic commercial lines produced experimentally are called genetically modified organisms GMOs. Many of the plants and animals used by humans today e. Cytogenetic techniques Cytogenetics focuses on the microscopic examination of genetic components of the cell , including chromosomes, genes, and gene products. Older cytogenetic techniques involve placing cells in paraffin wax , slicing thin sections, and preparing them for microscopic study. The newer and faster squash technique involves squashing entire cells and studying their contents. Dyes that selectively stain various parts of the cell are used; the genes, for example, may be located by selectively staining the DNA of which they are composed. Radioactive and fluorescent tags are valuable in determining the location of various genes and gene products in the cell. Tissue-culture techniques may be used to grow cells before squashing; white blood cells can be grown from samples of human blood and studied with the squash technique. One major application of cytogenetics in humans is in diagnosing abnormal chromosomal complements such as Down syndrome caused by an extra copy of chromosome 21 and Klinefelter syndrome occurring in males with an extra X chromosome. Some diagnosis is prenatal, performed on cell samples from amniotic fluid or the placenta. Biochemical techniques Biochemistry is carried out at the cellular or subcellular level, generally on cell extracts. Biochemical techniques are used to determine the activities of genes within cells and to analyze substrates and products of gene-controlled reactions. In one approach, cells are ground up and the substituent chemicals are fractionated for further analysis. For example, more than different kinds of human hemoglobin molecules have been identified. Radioactively tagged compounds are valuable in studying the biochemistry of whole cells. For example, thymine is a compound found only in DNA; if radioactive thymine is placed in a tissue-culture medium in which cells are growing, genes use it to duplicate themselves. When cells containing radioactive thymine are analyzed, the results show that, during duplication, the DNA molecule splits in half, and each half synthesizes its missing components. Chemical tests are used to distinguish certain inherited conditions of humans; e. Some of these tests can be applied to fetuses in utero. Physiological techniques Physiological techniques, directed at exploring functional properties or organisms, are also used in genetic investigations. In microorganisms, most genetic variations involve some important cell function. Some strains of one bacterium Escherichia coli , for example, are able to synthesize the vitamin thiamin from simple compounds; others, which lack an enzyme necessary for this synthesis, cannot survive unless thiamin is already present. The two strains can be distinguished by placing them on a thiamin-free mixture: The technique also is applied to human cells, since many inherited human abnormalities are caused by a faulty gene that fails to produce a vital enzyme; albinism , which results from an inability to produce the pigment melanin in the skin, hair, or iris of the eyes, is an example of an enzyme deficiency in man. Molecular techniques Although overlapping with biochemical techniques, molecular genetics techniques are deeply involved with the direct study of DNA. This field has been revolutionized by the invention of recombinant DNA technology. The DNA of any gene of interest from a donor organism such as a human can be cut out of a chromosome and inserted into a vector to make recombinant DNA, which can then be amplified and manipulated, studied, or used to modify the genomes of other organisms by transgenesis. A fundamental step in recombinant DNA technology is

amplification. This is carried out by inserting the recombinant DNA molecule into a bacterial cell, which replicates and produces many copies of the bacterial genome and the recombinant DNA molecule constituting a DNA clone. A collection of large numbers of clones of recombinant donor DNA molecules is called a genomic library. Such libraries are the starting point for sequencing entire genomes such as the human genome. Steps involved in the engineering of a recombinant DNA molecule. Immunological techniques Many substances e. Various antigens exist in red blood cells, including those that make up the major blood group s of man A, B, AB, O. These and other antigens are genetically determined; their study constitutes immunogenetics. Blood antigens of man include inherited variations, and the particular combination of antigens in an individual is almost as unique as fingerprints and has been used in such areas as paternity testing although this approach has been largely supplanted by DNA-based techniques. HudsonAlpha Institute for Biotechnology Immunological techniques are used in blood group determinations in blood transfusion s, in organ transplants, and in determining Rhesus incompatibility in childbirth. Specific antigens of the human leukocyte antigen HLA genes are correlated with human diseases and disease predispositions. Antibodies also have a genetic basis, and their seemingly endless ability to match any antigen presented is based on special types of DNA shuffling processes between antibody genes. Immunology is also useful in identifying specific recombinant DNA clones that synthesize a specific protein of interest. Mathematical techniques Because much of genetics is based on quantitative data, mathematical techniques are used extensively in genetics. The laws of probability are applicable to crossbreeding and are used to predict frequencies of specific genetic constitutions in offspring. Geneticists also use statistical methods to determine the significance of deviations from expected results in experimental analyses. In addition, population genetics is based largely on mathematical logicâ€”for example, the Hardy-Weinberg equilibrium and its derivatives see above. Bioinformatics uses computer-centred statistical techniques to handle and analyze the vast amounts of information accumulating from genome sequencing projects. The computer program scans the DNA looking for genes, determining their probable function based on other similar genes, and comparing different DNA molecules for evolutionary analysis. Bioinformatics has made possible the discipline of systems biology , treating and analyzing the genes and gene products of cells as a complete and integrated system. Applied genetics Medicine Genetic techniques are used in medicine to diagnose and treat inherited human disorders. Knowledge of a family history of conditions such as cancer or various disorders may indicate a hereditary tendency to develop these afflictions. Cells from embryonic tissues reveal certain genetic abnormalities, including enzyme deficiencies, that may be present in newborn babies, thus permitting early treatment. Many countries require a blood test of newborn babies to determine the presence of an enzyme necessary to convert an amino acid , phenylalanine , into simpler products. Phenylketonuria PKU , which results from lack of the enzyme, causes permanent brain damage if not treated soon after birth. Many different types of human genetic diseases can be detected in embryos as young as 12 weeks; the procedure involves removal and testing of a small amount of fluid from around the embryo called amniocentesis or of tissue from the placenta called chorionic villus sampling. Gene therapy is based on modification of defective genotypes by adding functional genes made through recombinant DNA technology. Agriculture and animal husbandry Agriculture and animal husbandry apply genetic techniques to improve plant s and animal s. Breeding analysis and transgenic modification using recombinant DNA techniques are routinely used. Animal breeders use artificial insemination to propagate the genes of prize bulls. Prize cows can transmit their genes to hundreds of offspring by hormone treatment, which stimulates the release of many eggs that are collected, fertilized, and transplanted to foster mothers. Several types of mammals can be cloned, meaning that multiple identical copies can be produced of certain desirable types. Dolly the sheep was successfully cloned in by fusing the nucleus from a mammary-gland cell of a Finn Dorset ewe into an enucleated egg cell taken from a Scottish Blackface ewe. Carried to term in the womb of another Scottish Blackface ewe, Dolly was a genetic copy of the Finn Dorset ewe. Plant geneticists use special techniques to produce new species, such as hybrid grains i. Plant breeders use the techniques of budding and grafting to maintain desirable gene combinations originally

obtained from crossbreeding. Transgenic plant cells can be made into plants by growing the cells on special hormones. The use of the chemical compound colchicine , which causes chromosomes to double in number, has resulted in many new varieties of fruit s, vegetable s, and flower s. Many transgenic lines of crop plants are commercially advantageous and are being introduced into the market. Industry Various industries employ geneticists; the brewing industry, for example, may use geneticists to improve the strains of yeast that produce alcohol. The pharmaceutical industry has developed strains of mold s, bacteria , and other microorganisms high in antibiotic yield. Penicillin and cyclosporin from fungi , and streptomycin and ampicillin from bacteria, are some examples. Biotechnology , based on recombinant DNA technology, is now extensively used in industry. Such products include pharmaceutical drugs and industrial chemicals such as citric acid.

Chapter 4 : Molecular Biology & Genetics Equipment

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Molecular biology is the study of development, structure and function of macromolecules vital for life. It deals with the molecular basis of biological activity and overlays genetics and biochemistry. It also includes biochemical and molecular influence on genetic material. The journal accepts manuscripts in the form of original research article, review article, short communication, case report, letter-to-the-Editor and Editorials for publication in an open access platform. The Journal is using Editor Manager System for easy online tracking and managing of the manuscript processing. Research in cell biology is closely related to genetics, biochemistry, molecular biology, immunology, and developmental biology. Genes are found in all living organisms and are transferred from one generation to the next. Gene technology encompasses several techniques including marker-assisted breeding, RNAi and genetic modification. Only some gene technologies produce genetically modified organisms. We use the most appropriate technique, or combination of techniques, to achieve the desired goal. Bioinformatics Bioinformatics is the application of computer technology to the management of biological information. Computers are used to gather, store, analyze and integrate biological and genetic information which can then be applied to gene-based drug discovery and development. Bioinformatics tools aid in the comparison of genetic and genomic data and more generally in the understanding of evolutionary aspects of molecular biology. At a more integrative level, it helps analyze and catalogue the biological pathways and networks that are an important part of systems biology. In structural biology, it aids in the simulation and modeling of DNA, RNA, and protein structures as well as molecular interactions. Mutations may or may not produce changes in the organism. Hereditary mutations and Somatic mutations are the two types of Gene mutations. Former type is inherited from the parents and are present in every cell of the human body whereas latter type may occur at some point of life time due to environmental factors.. Gene expression Gene expression is the process by which information from a gene is used in the synthesis of a functional gene product. These products are usually proteins which functions as enzymes, hormones and receptors. Gene expression is the process by which the genetic code the nucleotide sequence of a gene is used to direct protein synthesis and produce the structures of the cell. Genes that code for amino acid sequences are called as structural genes. Molecular cloning Molecular cloning is a set of techniques used to insert recombinant DNA from a prokaryotic or eukaryotic source into a replicating vehicle such as plasmids or viral vectors. Cloning refers to making numerous copies of a DNA fragment of interest, such as a gene. Genetics, Advances in Genetics. Molecular Genetics Molecular genetics is a branch of genetics and molecular biology that deals with the structure and function of genes at a cellular and molecular level. One of the main achievements of molecular genetics is that now one can have the clarity about the chemical nature of the gene. Gene amplification, separation and detection, and expression are some of the general techniques used for molecular genetics. The term immunogenetics is based on two words immunology and genetics. Related Journals of Immunogenetics Immunogenetics: Evolutionary Genetics Evolutionary Genetics is the study of how genetic variations leads to evolutionary changes. Gene Mapping The methods used to identify the locus of a gene and the distances betweengenes. Cloning Cloning is defined as the processes used to create copies of DNA fragments, cells or organisms. Cloning is commonly used to amplify DNA fragments containing whole genes, but it can also be used to amplify any DNA sequence such as promoters, non-coding sequences and randomly fragmented DNA. It is widely used technique of biological experiments and practical applications including genetic fingerprinting to large scale protein production. It includes any method or technology that is used to determine the order of the four basesâ€”adenine, guanine, cytosine, and thymineâ€”in a strand of DNA. Genetic Engineering Genetic Engineering is a technique of controlled manipulation of genes to change the genetic makeup of cells and move genes across species boundaries to

produce novel organisms. Molecular Medicine Molecular Medicine strives to promote the understanding of normal body functioning and disease pathogenesis at the molecular level, and to allow researchers and physician-scientists to use that knowledge in the design of specific tools for disease diagnosis, treatment, prognosis, and prevention. The field overlaps with other areas of biology and chemistry, particularly genetics and biochemistry. Cell biology studies the properties of cells including their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division and death. Molecular and cellular biology are interrelated, since most of the properties and functions of a cell can be described at the molecular level. Molecular and cellular biology encompass many biological fields including: Auto immune Disorders Autoimmune disorders are caused when immune system of the body reacts, against our own body, thus leading to many autoimmune disorders. There are several autoummune disorders they are celiac diseases, diabetes mellitus, graves diseases. These instructions are found inside every cell, and are passed down from parents to their children. DNA is made up of molecules called nucleotides. Each nucleotide contains a phosphate group, a sugar group and a nitrogen base. Genetic Disorders A genetic disorder is a genetic problem caused by one or more abnormalities in the genome, especially a condition that is present from birth. Abnormalities can also be small as single base mutation. They can also involve addition or subtraction of entire chromosome. There are four groups of genetic disorders like single gene disorders, chromosome abnormalities, mitochondrial disorders and multifactorial disorders. Heredity The passing on of traits from one generation to another generation. Human genetics is the study of inheritance in human beings. Human characteristics are inherited from parents to offspring in discrete unites called genes. Genes consist of specific information coded in the chromosome that consists of segments of chromosomes. Human genetics includes a variety of overlapping fields like classical, molecular, biochemical, population, developmental, clinical and cytogenetics. Current Research , General Medicine: Okra Abelmoschus esculentus L. The genetic diversity of Okra was analyzed to provide the theoretical ba

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Chapter 5 : Molecular biology - Wikipedia

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Chapter 6 : Genetics and Molecular Biology Research

Genetics & Molecular Biology - Chapter Summary. Strengthen your level of expertise in the study of basic genetics by reviewing these lessons on the composition and role of nucleic acids, mutations.

Relationship to other biological sciences[edit] Schematic relationship between biochemistry , genetics and molecular biology Researchers in molecular biology use specific techniques native to molecular biology but increasingly combine these with techniques and ideas from genetics and biochemistry. There is not a defined line between these disciplines. The figure to the right is a schematic that depicts one possible view of the relationships between the fields: Biochemists focus heavily on the role, function, and structure of biomolecules. The study of the chemistry behind biological processes and the synthesis of biologically active molecules are examples of biochemistry. This can often be inferred by the absence of a normal component e. The study of " mutants " â€" organisms which lack one or more functional components with respect to the so-called " wild type " or normal phenotype. Genetic interactions epistasis can often confound simple interpretations of such " knockout " studies. The central dogma of molecular biology where genetic material is transcribed into RNA and then translated into protein , despite being oversimplified, still provides a good starting point for understanding the field. The picture has been revised in light of emerging novel roles for RNA. In the early s, the study of gene structure and function, molecular genetics , has been among the most prominent sub-fields of molecular biology. Increasingly many other areas of biology focus on molecules, either directly studying interactions in their own right such as in cell biology and developmental biology , or indirectly, where molecular techniques are used to infer historical attributes of populations or species , as in fields in evolutionary biology such as population genetics and phylogenetics. There is also a long tradition of studying biomolecules "from the ground up" in biophysics. For more extensive list on nucleic acid methods, see nucleic acid methods. Molecular cloning Transduction image One of the most basic techniques of molecular biology to study protein function is molecular cloning. A vector has 3 distinctive features: Located upstream of the multiple cloning site are the promoter regions and the transcription start site which regulate the expression of cloned gene. This plasmid can be inserted into either bacterial or animal cells. Introducing DNA into bacterial cells can be done by transformation via uptake of naked DNA, conjugation via cell-cell contact or by transduction via viral vector. Introducing DNA into eukaryotic cells, such as animal cells, by physical or chemical means is called transfection. Several different transfection techniques are available, such as calcium phosphate transfection, electroporation , microinjection and liposome transfection. The plasmid may be integrated into the genome , resulting in a stable transfection, or may remain independent of the genome, called transient transfection. A variety of systems, such as inducible promoters and specific cell-signaling factors, are available to help express the protein of interest at high levels. Large quantities of a protein can then be extracted from the bacterial or eukaryotic cell. The protein can be tested for enzymatic activity under a variety of situations, the protein may be crystallized so its tertiary structure can be studied, or, in the pharmaceutical industry, the activity of new drugs against the protein can be studied. The reaction is extremely powerful and under perfect conditions could amplify one DNA molecule to become 1. The PCR technique can be used to introduce restriction enzyme sites to ends of DNA molecules, or to mutate particular bases of DNA, the latter is a method referred to as site-directed mutagenesis. Proteins can be separated on the basis of size by using an SDS-PAGE gel, or on the basis of size and their electric charge by using what is known as a 2D gel electrophoresis. DNA samples before or after restriction enzyme restriction endonuclease digestion are separated by gel electrophoresis and then transferred to a membrane by blotting via capillary action. The membrane is then exposed to a labeled DNA probe that has a complement base sequence to the sequence on the DNA of interest. These blots are still used for some applications, however, such as measuring transgene copy number in transgenic mice or in the engineering of gene knockout embryonic stem cell lines. Northern blot Northern blot diagram The northern blot is used to study the expression patterns of a specific

type of RNA molecule as relative comparison among a set of different samples of RNA. It is essentially a combination of denaturing RNA gel electrophoresis , and a blot. In this process RNA is separated based on size and is then transferred to a membrane that is then probed with a labeled complement of a sequence of interest. The results may be visualized through a variety of ways depending on the label used; however, most result in the revelation of bands representing the sizes of the RNA detected in sample. The intensity of these bands is related to the amount of the target RNA in the samples analyzed. The procedure is commonly used to study when and how much gene expression is occurring by measuring how much of that RNA is present in different samples. It is one of the most basic tools for determining at what time, and under what conditions, certain genes are expressed in living tissues. Western blot In western blotting , proteins are first separated by size, in a thin gel sandwiched between two glass plates in a technique known as SDS-PAGE. The proteins in the gel are then transferred to a polyvinylidene fluoride PVDF , nitrocellulose, nylon, or other support membrane. This membrane can then be probed with solutions of antibodies. Antibodies that specifically bind to the protein of interest can then be visualized by a variety of techniques, including colored products, chemiluminescence , or autoradiography. Often, the antibodies are labeled with enzymes. When a chemiluminescent substrate is exposed to the enzyme it allows detection. Using western blotting techniques allows not only detection but also quantitative analysis. Analogous methods to western blotting can be used to directly stain specific proteins in live cells or tissue sections. Eastern blot The eastern blotting technique is used to detect post-translational modification of proteins. Proteins blotted on to the PVDF or nitrocellulose membrane are probed for modifications using specific substrates.

Chapter 7 : Journal of Genetic, Molecular and Cellular Biology

Editorial: Methods for studying the genetics, molecular biology, physiology, and pathogenesis of the streptococci / Paula Fives-Taylor and Donald J. DeBlanc Tn transponson mutagenesis and marker rescue of interrupted genes of Streptococcus mutans /.

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This book is devoted entirely to methods developed in and for studies of members of the bacterial family Streptococcaceae. Many of the studies that have been conducted on the Streptococcaceae were ini.

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Molecular biology / m É™ Ëˆ l É› k j ÊŠ l É™r / is a branch of biology that concerns the molecular basis of biological activity between biomolecules in the various systems of a cell, including the interactions between DNA, RNA, proteins and their biosynthesis, as well as the regulation of these interactions.