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Mobilization and Reassembly of Genetic Information documents the proceedings of the Miami Winter Symposium, sponsored by the Department of Biochemistry, University of Miami School of Medicine, Miami, Florida, January This volume is the 17th in the ""Miami Winter Symposia"" series.

Schematic drawing of bacterial conjugation. Conjugation diagram Donor cell produces pilus. Pilus attaches to recipient cell and brings the two cells together. The mobile plasmid is nicked and a single strand of DNA is then transferred to the recipient cell. Both cells synthesize a complementary strand to produce a double stranded circular plasmid and also reproduce pili; both cells are now viable donor for the F-factor. It carries its own origin of replication , the oriV, and an origin of transfer, or oriT. Among other genetic information, the F-plasmid carries a tra and trb locus , which together are about 33 kb long and consist of about 40 genes. The tra locus includes the pilin gene and regulatory genes, which together form pili on the cell surface. Though there is some debate on the exact mechanism of conjugation it seems that the pili are not the structures through which DNA exchange occurs. This has been shown in experiments where the pilus are allowed to make contact, but then are denatured with SDS and yet DNA transformation still proceeds. Several proteins coded for in the tra or trb locus seem to open a channel between the bacteria and it is thought that the traD enzyme, located at the base of the pilus, initiates membrane fusion. When conjugation is initiated by a signal the relaxase enzyme creates a nick in one of the strands of the conjugative plasmid at the oriT. Relaxase may work alone or in a complex of over a dozen proteins known collectively as a relaxosome. The remaining strand is replicated either independent of conjugative action vegetative replication beginning at the oriV or in concert with conjugation conjugative replication similar to the rolling circle replication of lambda phage. Conjugative replication may require a second nick before successful transfer can occur. A recent report claims to have inhibited conjugation with chemicals that mimic an intermediate step of this second nicking event. The insertion sequences yellow on both the F factor plasmid and the chromosome have similar sequences, allowing the F factor to insert itself into the genome of the cell. This is called homologous recombination and creates an Hfr high frequency of recombination cell. The Hfr cell forms a pilus and attaches to a recipient F- cell. DNA begins to be transferred from the Hfr cell to the recipient cell while the second strand of its chromosome is being replicated. The pilus detaches from the recipient cell and retracts. The Hfr cell ideally wants to transfer its entire genome to the recipient cell. However, due to its large size and inability to keep in contact with the recipient cell, it is not able to do so. The F- cell remains F- because the entire F factor sequence was not received. Since no homologous recombination occurred, the DNA that was transferred is degraded by enzymes. In very rare cases, the F factor will be completely transferred and the F- cell will become an Hfr cell. In common laboratory strains of E. The transferred DNA can then be integrated into the recipient genome via homologous recombination. A cell culture that contains in its population cells with non-integrated F-plasmids usually also contains a few cells that have accidentally integrated their plasmids. It is these cells that are responsible for the low-frequency chromosomal gene transfers that occur in such cultures. Some strains of bacteria with an integrated F-plasmid can be isolated and grown in pure culture. Because such strains transfer chromosomal genes very efficiently they are called Hfr high frequency of recombination. The genes that were transferred were then investigated. Since integration of the F-plasmid into the E. The lengths of the donor segments vary widely, but have an average length of Since a mean of 13 tracts are transferred, the average total of transferred DNA per genome is kb. Inter-kingdom transfer[edit] Agrobacterium tumefaciens gall at the root of Carya illinoensis. Bacteria related to the nitrogen fixing Rhizobia are an interesting case of inter-kingdom conjugation. The expression of these genes effectively transforms the plant cells into opine -producing factories. Opines are used by the bacteria as sources of nitrogen and energy. Infected cells form crown gall or root tumors. The Ti and Ri plasmids are thus endosymbionts of the bacteria, which are in turn endosymbionts or parasites of the infected plant. The Ti and Ri plasmids can also be transferred between

bacteria using a system the tra, or transfer, operon that is different and independent of the system used for inter-kingdom transfer the vir, or virulence , operon. Such transfers create virulent strains from previously avirulent strains. Genetic engineering applications[edit] Conjugation is a convenient means for transferring genetic material to a variety of targets. In laboratories, successful transfers have been reported from bacteria to yeast, [14] plants, mammalian cells, [15] [16] diatoms [17] and isolated mammalian mitochondria. In plant engineering, Agrobacterium-like conjugation complements other standard vehicles such as tobacco mosaic virus TMV. While TMV is capable of infecting many plant families these are primarily herbaceous dicots. Agrobacterium-like conjugation is also primarily used for dicots, but monocot recipients are not uncommon.

Chapter 2 : - NLM Catalog Result

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 Very often exquisitely small amounts of these novel chemical compounds are toxic at extremely low levels to CNS and PNS structure and function. Even pharmaceuticals are hepatotoxic at some level, and this is of increased concern in the elderly who have compromised hepatic function in their old age. Globally, and especially in recent years: Indeed it is well beyond the current capacity of human environmental and toxicological science to understand the combined interactive effects of how , novel chemical compounds could simultaneously interact with each other and how together they could impact human physiology, neurochemistry and neurobiology and contribute to neurological disease. With rapidly expanding human populations and the technology-driven need for novel chemicals, including pesticides and herbicides used to enhance food production, we can expect these kinds of problems to become even more significant and complex in the foreseeable future. The Mobilization of Neurotoxins into the Biosphere: Focus on Aluminum In concert with the global generation of new chemical compounds is the mobilization of normally earth-bound neurotoxins, and here we will underscore the remarkable and ongoing liberation of aluminum into the biosphere, resulting in its increased bioavailability to neurobiological systems. Global demand for aluminum from developing countries is increasing, due in part to new applications for aluminum and aluminum alloys for multiple applications in aviation, aerospace, munitions, electrical transmission and energy generation, in infrastructural support including construction, in transportation, packaging, and in food and medical applications [4 â€” 6 , 8 , 9]. In parallel with the massively increased bioavailability of aluminum are the increased global production and mobilization into the environment of other neurotoxic elements, gases and metals, chiefly lead, mercury, chrome, cadmium, carbon and nitric oxides and others [6 , 9]. Therefore, in addition to the thousands of new chemicals being generated and released into our biosphere the sum of all ecosystems and living organisms on the earth we see a parallel mobilization of normally earthbound neurotoxic and genotoxic elements [8 , 9]. Interestingly, certain chemical compounds such as glyoxalates and aluminum as, for example, in the vaccine adjuvant aluminum oxide or the common food additive aluminum maltolate have been implicated in the development of several human neurological disorders including AD and ASD [7 â€” 16]. Major recent results of these studies indicate: Hence, depending on genotypic or phenotypic considerations, certain individuals or population groups may be chronically predisposed to the multiple effects of neurotoxic and genotoxic agents over the course of a lifetime. Worldwide, an estimated 46, tons of aspirin are consumed each year [28 â€” 30]. The preferred treatment is avoidance of exposure to aspirin itself [28 â€” 32]. Aluminum neurotoxicity can therefore be thought of in a similar fashion â€” that some individuals can adequately tolerate aluminum exposure, either chronic or acute, while others simply cannot. Hence neurological diseases such as AD and ASD may be the result of the poorly understood parameters that contribute to human biochemical individuality. These are against either i a background of brain development in the case of children; or ii over the course of aging and in the elderly when normally protective physiological barriers such as the gastrointestinal GI tract and blood-brain barrier BBB are either not fully formed or begin to break down with age, and leak environmentally-abundant neurotoxins into susceptible and sensitive biological compartments [9 â€” 16 , 33 â€” 35]. The Outlook for the Future Each year the earth adds to its population about 81,, individuals with each individual carrying the potential for the development at least 14, different diseases [2 , 3 , 16 â€” 18 , 36]. These increases in population and incidence of disease occur against a background where more and more medical research and healthcare is urgently needed yet less and less is readily available. This alarming combination of increasing population growth that includes genetically

susceptible human individuals, and increased mobilization of multiple forms of normally earthbound and synthetic neurotoxins, genotoxins, novel chemical compounds, hydrocarbons including carbon and nitrogen oxides and related greenhouse gases, and other disease-causing agents into our environment continues to overwhelm our scientific and medical capability to understand their complex environmental, genetic and epigenetic interactions and address them as potentially serious healthcare concerns. Given the appropriate incubation period in genetically sensitive hosts these exposures can ultimately contribute to AD or ASD, as well as other serious incapacitating neurological diseases of the human CNS [6 â€" 15]. Summary Humankind has inadvertently designed a remarkably precarious combination of rapidly increasing and unchecked population growth with an increased liberation of novel and potentially pathogenic chemical compounds and neurotoxins into the biosphere. Parallel increases in the deleterious consequences of unrestricted population growth and diseasecausing toxic exposures in our environment are on the horizon. Globally this poses very significant socioeconomic and healthcare concerns that have been neglected for far too long. To cite one important example, since there is abundant evidence that neurotoxic compounds such as aluminum may play initiator or disease-propagating roles for AD, ASD and other progressive, age-related neurological diseases, then we should expect these kinds of exposure situations that can adversely affect human health and welfare to become even more common and widespread in the foreseeable future [7 â€" 27]. This may be particularly important socioeconomically and epidemiologically due in part to the excessive and additional burden it will place on our already strained healthcare system both here in the United States and in global situations where even basic healthcare systems remain underdeveloped or are simply unavailable to the local human population. Sincere thanks are extended to D Guillot for expert technical assistance.

Chapter 3 : Bacterial conjugation - Wikipedia