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Newsletter

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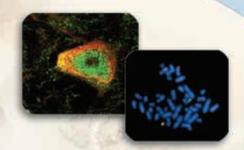
ESCELLENCE

In Genomic Medicine Research

Special Features



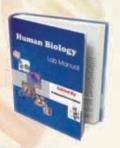
CEGMR on Scientific Mission in India



Research Updates



CEGMR Activities



Book Review "Human Biology Lab Manual"





Editorial

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Designers Reem Bashmail Nesreen Al Zahrani Dear Colleagues,

The way modern life scientists approach a scientific question has changed considerably over the past decades. While in the eighties they were satisfied with working on a single



gene, a single enzyme or a biochemical pathway, today the expectation is that one should approach a biological phenomenon by investigating a multitude of genes, proteins, and structures by examining hundreds and thousands of samples at the same time. This change has been brought about by increasingly sophisticated and high-throughput technologies which reduce the cost and time needed for each sample or measurement, and increase the wealth of data. The special issue of the Genemercell Newsletter highlights this aspect along with some of the important events taking place at the CEGMR to gear itself for modern technologies. Over the past year a huge amount of work has been done to develop and implement the research technical supportive units. At present, CEGMR is applying a new orientation supported policy, which will help the researchers to accomplish their work in healthy environment. The new labs are being equipped with highly sophisticated advance equipments, and plans training technical staff with highly experience supervision. The Center is preparing to receive more interested researchers in the field of genomics. The type of research burgeoned from the objective of CEGMR aims to provide a platform for dialogue and education on issues related to human genetics and to bring together national and International experts to set the priorities for research on genetic disorders in the region. One of the most important attractions of the researchers will be the participation of the International research centers in scientific events in the region for the first time. Finally, this newsletter will explore all aspects of CEGMR work, present and future and is designed for those with professional or general interest. We would very much welcome any comments or suggestions for subsequent issues.





CEGMR on Scientific Mission in India

Centre of Excellence in Genomic Medicine Research (CEGMR), following its successful

launching of major research programs, initiated the sweeping effort to modernize its existing facilities as well as to create modern laboratories in sophisticated areas like

Microarray, SNP's, and Stem cell research. To usher the CEGMR in crucial phase of acquiring skilled persons, it expanded its sport facilities, technician and senior technician pools. CEGMR has therefore taken upon itself to advertise through print media and online advertisements as a major recruitment drive to appoint experts from India, Japan, UK and USA. Under the supervision of CEGMR Director, Dr. Mohammed

Al Qahtani, certain centers carrying out research in human genetics in India were contacted and subsequent visiting schedule was outlined. The aim was to meet top notch scientists and personally see their laboratories and infrastructure.

> This was to identify areas of common interest, outline strategy of collaboration and sign MoU wherever possible. The selection and search committee consisted of Director, CEGMR, Dr.

Mohammed Hussain Al Qahtani, besides Deputy Directors and other officials: Dr. Adil Abuzenadah, Dr. Adeel G. Choudahary, Dr. Mamdooh Gari and Consultant Prof. Waseem Ahmad (Faridi). A brief summary of visit is as follows:

Visit to New Delhil

The delegation was based in New Delhi from 27th Feb. 08 to 3rd March 08 for an elaborate interactive program of CSIR Laboratories and to conduct interviews.

Institute of Genomics and Integrative Biology (IGIB)

The IGIB, a CSIR laboratory is a premier Institute carrying out research leading to generation



of new knowledge and development of technologies in various areas of science with a special focus on Genomics and Genome Informatics. Acting Director of IGIB, Dr. K. Gupta along with full staff of institute greeted the delegates. Director IGIB introduced the Institute.

Thereafter, Dr. Mohammad Al-Qahtani, expressed appreciation of the efforts of IGIB. He gave a very detailed introduction of CEGMR, elaborated on its vision and future plans. He stressed the need for dynamic collaboration and identified several areas of mutual interests. The faculty present in full strength introduced themselves and their



research of interests. In the end, the Director CEGMR presented the MoU for consideration. He was asked to sign the visitor's book and shield of appreciation was presented to him among the cheers of scientists. It was followed by sumptuous lunch.

The Centre for Genomic Applications (TCGA)

The CEGMR team headed to TCGA at Okhla industrial estate where the group was greeted by Dr. Narayanasamy. TCGA is the first public private life sciences center that has partnered with IGIB. After brief introduction, the group was allowed





to visit the laboratories and observe stringent quality control criteria in a diagnostic service



delivering laboratories. State of the art sequinome for protein arrays and fully functional MALDI-TOF mass spectrometer were demonstrated. The group freely discussed with working scientists and technologists about their experience with various equipments, their utilization and possible short comings. The group was seen off in the late afternoon.

Areas of possible collaboration were identified in oligonucleotide and FISH probe synthesis and labeling. Also potential drug designing and proteomics related collaborative research projects could be initiated. However, majority of the applications were in vaccine development for certain viral and bacterial genotypes specific for Indian ethnic populations.

National Institute of Immunology (NII)



The delegation visited NII the day next where on behalf of Prof. Surolia's group, Dr. Salunke and other scientists received the

delegation. After the mutual introduction, the delegation was informed that the research interests of the current groups coalesce in four major areas; Gene Regulation, Immunity & Infection, Molecular Design, and Reproduction & Development. Director, Mohammad Husain Al Qahtani, on his turn recognized that CEGMR was the first Saudi delegation from Middle East to visit these laboratories.

The strength of institute was identified in basic protein biology, receptor interaction and receptor binding. Potential collaboration in animal modeling was also identified as a powerful tool to study *in-vivo* disease genomics.

Interviews in New Delhi

CEGMR entertained short listed candidates for interviews at a prebooked



meeting lounge. The interviews were a result of advertisement placed in Hindustan Times job supplement, one of the most widely circulated newspapers in India having about 40 million with CEGMR job offers for subscribers, experienced human genetics and bio-informatics experts. The submitted resume were short listed to 52 and the candidates were distributed equally for interviews over two consecutive days. Interviews were conducted on 1st and 2nd of March' 2008 at 9:00 a.m. sharp and lasted until 5:30 p.m. Each candidate was given ample time for proper and fair evaluation. Dr. Al Qahtani was keen to determine the 'hands on' experience of the candidate and how could one contribute to CEGMR growth in shortest possible time. Extremely stringent questioning criteria were outlined that followed by all members and proper evaluation forms were filled for each candidate, and some of them short listed for CEGMR.

Visits by delegates of AIMS and Jamia Millia Islamia, New Delhi

In between the hectic schedule of interviews a few scientists, from All India Institute of Medical Sciences and Jamia Millia Islamia, New Delhi made themselves available on 2nd of March' 2008 at the Business Centre of Metropolitan Hotel. The delegation talked for cooperation and exchange programs and enthusiastically explored the mutual areas of interest.





Visit to Hyderabad

Center for Cellular and Molecular Biology (CCMB)



The next destination of CEGMR delegation was Hyderabad scheduled from 3rd March to 5th March 2008. Premier Institutes

and Universities were already in the itinerary of the delegation. The first of them being the Center for Cellular and Molecular Biology. Dr. Mercy Joseph, Deputy Director, Head, PME & HRG along with her team greeted at the conference room. Director CEGMR, introduced different activities of Center, notably related to research programs, technical aspects, outreach programs, followed by a brief elaboration on fundings.

Dr. Joseph in her address, to introduce the CCMB said: the main objectives of the centre are research frontier conduct in multidisciplinary areas of modern biology and to seek potential application of this work. delegation was introduced about the major areas of research undertaken by CCMB. Many Scientists from CCMB took their turn to introduce their respective fields of interest to delegates. Although housed in a modest building, the CCMB was extremely well equipped; their enormous budget was optimally utilized. The visit was an eye opener for CEGMR and provided an example of how world class results can be produced from basic, yet extremely well integrated network of scientific groups. CCMB strengths were identified in population genetics particularly in SNP analysis using microarray technology. Also, their structural protein work using NMR was worth appreciating.

Center for DNA Fingerprinting and Diagnostics (CDFD)

The second day at Hyderabad was devoted to visit CDFD. Director and Head, Laboratory of Bacterial Genetics, Dr. J. Gowarishankar received the delegation and escorted it to



conference room, where many scientists participated in the deliberations. As a protocol Dr. Gowarishankar introduced the CDFD. The Centre was established for DNA diagnostic methods for genetic disorders, and to develop probes for this purpose, besides using DNA fingerprinting for authentication of cell lines and cell material. In addition to undertaking basic, applied and R&D work, it provides training and consultancy to medical institutions, public health agencies, judiciary. strives industries and acquire or transfer technical know-how and actively collaborate with foreign research institutions and international organizations. Thereafter, Director CEGMR, Deputy Directors and Coordinator /Consultant took their turns elaborate important research programs, recent developments, technical and funding aspects of CEGMR.



Dr. Janila, Staff scientist took the delegates around various laboratories of CDFD, during which on the spot discussion with the support staff was

interesting. The delegates were presented with CDFD Annual Report of 2006-07. It was followed by an impressive ceremony of signing a Memorandum of Understanding between the Director, Centre of Excellence in Genomic Medicine Research, KAU, Jeddah, Dr. Mohammed Husein Al -Qahtani and Director, Center of DNA Fingerprinting and Diagnostics, Dr. Gowarishankar. The ceremony was covered by photographers. It was followed by lunch in the afternoon. The delegation presented the vote of thanks.





Visit to Mumbal

The Advanced Centre for Treatment, Research and Education in Cancer (ACTREC)



As per schedule, Dr. S. M. Zingde, Deputy Director CRI-ACTREC received the delegation at main reception and led it to

Board Room where group leaders and various scientists warmly greeted the delegates. Dr. Al-Qahtani, as director CEGMR, expressed his views and elaborated the Center's vision, objectives and strategy. He appreciated the Kingdom's dynamic approach towards establishing such Centers of excellence, the first such effort to introduce biotechnology at grass root level in the Kingdom of Saudi Arabia. He also emphasized the importance of active collaboration with similar centers in India.

Dr. Zingde introduced the ACTREC establishment and senior scientists presented their latest findings and its



diagnostic impact. The CEGMR team was invited on a detailed tour of ACTREC, consisting of state of the art laboratories where various sequencers, con-focal microscopes, Meta systems, protein arrays, MALDI-TOF were demonstrated. The visiting team was also taken to oncology center where they were shown the first Indian built Bhabhatron I & II radio imaging machines using indigenous 'in-house' technology. The unit was



inaugurated by IAEA director general, Dr. Mohamed El Baradei in 2006. The CEGMR group was also shown the recently established BMT center where so far 22 successful BMTs had already taken place within a span of four months. Various other facilities were also shown and the group met several Ph.D. students, senior technologists and post doctoral fellows. The visit was concluded with a sumptuous lunch hosted in the honor of the delegates.

A general consensus was reached upon carrying out joint research on various types of cancer. It was made clear that CEGMR was seeking transfer of expertise in human genetics rather than being a regular client seeking service.

Concluding the first round of tour, the delegation reached back to Delhi, to start the final leg of its itinerary.

Meeting with Director General CSIR India, New Delhi

The CEGMR team was invited to meet Prof. Samir Brahamchari at CSIR head quarters located at Mohammad Rafi Marg on 7th March' 2008, at 11:00 a.m. Prof. Brahamchari apprised the group of his vast experience and described his participation towards nation building since the independence of India in 1947, and subsequent creation of CSIR in 1950s. He explained the true meaning of 'indigenous' and 'reverse' technology that Indians believed in, and also recognized China as the main manufacturer while India being the main hub for science and technology and

fundamental research. As secretary to the government of India, he was also responsible for allocating and distributing funds to all CSIR laboratories. Dr. Mohammad Hussein Al Qahtani explained CEGMR mission and the benefits of collaborating with Prof. Brahamchari as an international consultant. Various senior scientists from CSIR, IGIB and TCGA also graced the occasion. The CEGMR visit and enthusiasm was appreciated and it was recognized as the first delegation of its kind from Middle East seeking active collaboration in biotechnology with India.



CEGMR Activities

Seminar on Personalized Medicine and Use of Cytogenetics in Hematologic Malignancies

A seminar was held at KFMRC auditorium on 26th Sept. 2007 corresponding to 14th Ramadan 1428 H. Dr. Gerald Walter and Dr Claudia Walter, both belonging to Germany delivered their lectures. Dr. Gerald spoke on personalized medicine covering Microarray, Neo Technologies, Robotized Techniques, and Genomic Designer Drugs. Dr. Walter talked at length on these topics candidly. He is associated with the biotechnology industry, Cambridge, UK.

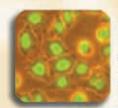


Dr.Claudia Walter, on her part delivered lecture on Application of Cytogenetics in Hematologic Malignancies. Dr. Claudia is a senior cytogeneticist. She specializes in cancer cytogenetics and is of late conducting research on lung cancer, breast cancer and soft tissue tumors.



Their lectures were well attended and many interesting questions pertaining to above topics were answered.

· aPCR/RNAi Workshop at CEGMR



A workshop on qPCR/Gene Transfer methods and RNAi was jointly organized by Al Jeel Medical Co. and Center of Excellence for Genomic Medicine Research in main auditorium of King Fahad Medical Research Center on 13 Nov.2007. Mr. Jozsef Palik, Product Manager, Bio-Rad Laboratories delivered a series of lectures on the following topics.

Real-Time PCR; from problems to perfection: The lecture stressed the need on how to use real time PCR as a valuable tool for gene expression study, covering optimization steps and main pitfalls and solutions. The talk dealt with how one can convert the actual assay easily to make reaction time much faster notwithstanding expensive reagents and special reaction block.



RNA interference technology: The lecture dealt with the basics and explained the use of various substrates. An overview of RNA and importance of using the technology was elucidated.

Gene Silencing: This lecture concentrated on Beta action, gene silencing and its effects using protein and genomic analysts tools. Besides, electroporation with the new gene pulsar Maxell was also presented to selected audience. These lectures were well attended, and questions pertaining to above topics were defended adequately by the speaker.

International Symposium & Workshops; Current Concepts & Issues in Pathology & Laboratory Medicine



A three-day workshop on anatomical and clinical pathology was held at King Saud University for Medical Sciences, Riyadh from 19 Nov. 2007 - 21 Nov. 2007. It was inaugurated by HRH Prince Metib bin Abdullah bin AbdulAziz Al Saud. Various sessions spreading over three days were devoted to Anatomical Pathology, represented by Molecular, Hormonal, and Cytological aspects. Many scholars presented their research





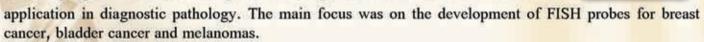
work and organized workshops. The Center of Excellence in Genomic Medicine Research was represented by Dr. Mohammad Husain Al Qahtani, Director CEGMR; Dr. Adil Abuzenadah and Dr. Adeel G. Chaudhary. Dr. Abuzenadah delivered a lecture on 'Molecular Solutions for Hematological Disorder'. It was followed by a very candid talk on 'Molecular Biology; an Integral Part of Diagnostic Laboratory' by Dr. Chaudhary. During discussion Dr. Chahudhary and Dr. Qahtani further pointed out the importance of diagnosis of Molecular Biology in clinical diagnosis of the disease, identification of gene carriers and predictive testing of subjects at a risk of developing it. Concerns were raised about mushrooming independent diagnostic molecular biology labs operated by professionally untrained technical staff and clinicians in Saudi Arabia as it has created more confusion than credibility.

Dr. Abuzenadah, Dr. Chaudhary and Dr. Mohammad H. Al Qahtani recommended some useful suggestions in order to maximize benefits from, and to ensure thorough nurturing of this cutting-edge technology.

· Seminar on FISH Technology in Oncology Diagnosis

The Center of Excellence in Genomic Medicine Research (CEGMR) facilitated the organizers, Vysis and Abbott Molecular, Jeddah to arrange a comprehensive seminar on the usefulness of FISH technology in oncology on 18th February 2008 at the main auditorium of KFMRC.

The day-long seminar started with welcome address followed by a lecture on the use of FISH technique in pre-and postnatal diagnostics by Dr. Edwin Roovers (Netherlands). Another comprehensive lecture and demonstration by Dr. Stephen Hall (UK) highlighted the molecular genomic changes in carcinomas and their clinical



It was followed by a coffee break, whereafter a report on Her-2/neu was presented by Dr. Merdol Ibrahim, Director, NEQAS SCHEME, (UK). The implications of FISH and IHC for selection of patients in therapy was the main essence of his talk. Finally, the lecture delivered by Dr. Stephen Hall was about the FISH probes in Hematological Malignancies and their implications in patient management.

Each session had question hour. The response of the participants was adequate. The Seminar concluded with a sumptuous lunch, courtesy, the organizers.

Training Program in CEGMR/GMU



A detailed and comprehensive training program for technicians and research assistants was organized by GMU/CEGMR laboratories beginning from 12 January 2008. The course was conducted under the guidance of Dr. Mohammad Al Qahtani, Director GMU/CEGMR and assisted by Mr. Emad Abdullah Al Hamzy.

The training took place at GMU in coordination with Deanship for Public Services and Continuing Education, a government institute affiliated with King Abdulaziz University. During this period, the trainees were supervised on day-to-day basis and were exposed to technical examination. They also gained theoretical knowledge by attending specialized lectures delivered by resource persons.





About fifteen participants were benefited from this three-month program comprising two main themes: cytogenetics and molecular genetics. Cytogenetic module comprised of theoretical and practical aspects covering identification of chromosomes processing by computer and image analysis, culturing, harvesting and staining of chromosomes including fish techniques and various case studies of acquired chromosomal changes in human leukemias. Whereas, molecular genetics module had, in

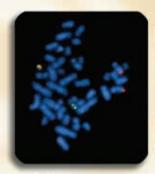


addition to the theoretical aspects, on-hand practical exposure to DNA/RNA extraction, PCR, nested PCR, RT-PCR, Hot Start PCR, gel electrophoresis, SCGE, RFLP, application of restriction enzymes, and bioinformatics. Both the components were successfully concluded within a stipulated time.

The trainees spent a total of three months at CEGMR/GMU where six weeks were utilized to acquaint with cytogenetic technique and six weeks for molecular biology techniques. It was followed by evaluation at various levels and trainees were granted a certificate of completion in the field of cytogenetics and molecular biology.

Research Updates

• TOP2A FISH technique, a reliable test for breast cancer



Every year the scientists make further steps to try and predict the risk of breast cancer recurrence. In planning treatment, doctors can use PCR tests like Oncotype DX or microarray tests like Mamma Print that predict breast cancer recurrence risk based on gene expression.

The Mamma Print test became the first breast cancer predictor to win formal approval from FDA. This is a new gene test to help predict whether women with early-stage breast cancer will relapse in subsequent years. This could help influence how aggressively the initial tumor is treated.

However, a new revolutionary test – the TOP2A FISH pharmDx has potential to detect topoisomerase 2 alpha gene in cancer patients. The approval of the new technique was based on a study of tumor samples and clinical evaluation of 767 women with breast cancers of a high risk of recurrence.

TOP2A FISH pharmDx uses FISH (Fluorescent in situ hybridization) - a cytogenetic technique that can be used to detect and localize the presence or absence of specific DNA sequences on chromosomes. It uses fluorescent probes that bind only those parts of the chromosome with which they show a high degree of sequence similarity. Fluorescence microscopy can be used to find out where the fluorescent probe is bound to the chromosome. FISH is often used for finding specific features in DNA.

In evaluation of cancer remission a traditional exam involving metaphase chromosome analysis is often unable to identify features that distinguish one disease from another due to subtle chromosomal features; FISH can elucidate these differences. FISH can also be used to detect diseased cells more easily than standard cytogenetic methods, which require dividing cells and requires labor and time-intensive manual preparation and analysis of the slides by a technologist. FISH, on the other hand, does not require living cells and can be quantified automatically, as a computer counts the fluorescent dots present. However, a trained technologist is required to distinguish subtle differences in banding patterns on metaphase chromosomes.

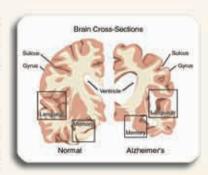




Alzheimer's Disease: A Family Affair

Alzheimer's disease is a common cause of dementia in many a developed countries. It affects about six percent to fourteen percent of the general population, but if both parents are diagnosed with the disease, the risk increases.

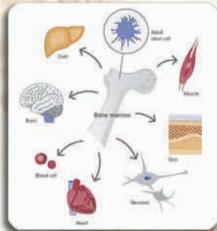
As the researchers at the University of Washington in Seattle studied the adult-aged children where both parents had been clinically diagnosed with Alzheimer's disease, they found one fourth of the offsprings developed the illness. The average age at onset was 66.3 years, but the scientists found the



incidence of Alzheimer's increased with age. The role of family history and the specific genes involved in this phenomenon require a better definition. A gene called ApoE [apolipoprotein E] is a known genetic risk factor for Alzheimer's disease in the general population.

Ivanhoe interview with Thomas D. Bird, M.D., Archives of Neurology, 2008; 65: 373-378

· Cure by Adult Stem Cells



The treatment with adult stem cells is ethically completely straightforward because it is found in the body of each adult human being. The largest reservoir of adult stem cells is located in the bone marrow of the longer bones. This is in contrast to embryonic stem cells where these cells can only be obtained by killing an embryo, an unethical practice.

Most cells in the human body are specialists. They function as blood, heart or muscle cells. Stem cells, by contrast, have no fixed function. They can be divided and multiplied, and are responsible for ensuring that damaged cells are exchanged to heal injuries. These so-called adult stem cells can even develop a specific organ.

The fresh blood cells ensure success in leukemia patients. The stem cells for research or treatment are ethically entirely unproblematic. The stem cell of a few days old embryos are not specialized cells, therefore, called as toti or pluripotent. Although we can not cure, the body can heal itself in the affected regions by offering one's own adult stem cells in concentrated form.

Positive experience has been gathered in various clinical syndromes, such as stroke, diabetes, multiple sclerosis, Parkinson's, Alzheimer's, spinal cord injury, liver disease and arthritis. The result has so far been encouraging.

· Bloactive Scaffolds

Scientists at the Edinburgh University in the UK are close to developing a treatment which they claim will mend shattered bones or ripped cartilage using a person's own stem cells.

The so called bioactive scaffold treatment involves taking stem cells from blood or bone marrow of people with serious injuries and prompting them to grow into the type of bone or tissue needed to heal the damage.







The scaffold is impregnated with a drug that helps the stem cells take hold. This would also mean the patient does not have to undergo surgery to harvest the cells.

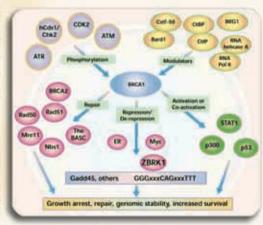
The success depends on encouraging the stem cells to grow effectively in harsh environments. The Techniques will be tested in patients in a period of two years.

http://timesofindia.indiatimes.com/HealthSci/Fractures

BRCA1 gene repair DNA damage, if not mutated

A newly discovered role played by the breast cancer gene BRCA1 in repairing damaged DNA may help explain why women who inherit a mutated version of the gene are more likely to develop breast and ovarian cancer. The finding can lead to more effective treatments for women with and without mutated versions of the gene.

The role of BRCA1 in preventing and causing cancer has been intensely studied. The study has identified an important mechanism by which BRCA1 comes into play when DNA - the basis for all cell function - is damaged. The BRCA1 pathway identified by the researchers is directly involved with the critical process of

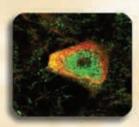


transcription, in which RNA acts as a messenger between DNA and the making of proteins.

It was found that BRCA1 acts together with transcription to detect DNA damage and to signal the cell to repair itself. When BRCA1 is mutated and does not function correctly, DNA damage remains un-repaired and cancer can occur. The finding was first made in yeast and then duplicated in human breast cancer cells.

http://sciencedaily.com/releases/2008/01/080131101753.htm

Nanoparticles as Vectors for Gene Therapy



Gene therapy, in which a viral vector is used to replace missing genes or modify defective ones has proved of great potential in treating diseases in animals. But its use in human beings has been obstructed by safety concerns as there were some fatalities in clinical trials. Therefore, researchers have now been looking into the possibilities of using nonverbal vectors, which should carry fewer inherent risks to deliver therapeutic genes.

Some researchers manufactured nano particles using organically modified silicon. The surface of these particles can be tailored to target specific cells. The team used the tiny units to transport a fluorescent marker gene to dopamine neurons in the brains of mice after injecting the nanoparticles. The researchers observed brain cells fluorescing by using a new imaging technique that works on live animals. According to the report, the study is the first in which a nonviral vector has shown more efficacy in comparison to that of a viral delivery system in an animal model. Moreover, it was observed that none of the animals showed adverse effects from the procedure even after a month.

Human Biology





Book Review

"Human Biology Lab Manual"

The book, 'Human Biology Lab. Manual,' has been edited by Dr. Mohammad Hussain Al Qahtani, (Former Head) Director, CEGMR and Assistant Professor, Department of Medical Biology, College of Medicine, KAU. The authors who contributed to relevant text are: Professor Waseem Ahmad (Faridi), Professor Abdul-Rahman FaragAllah, Dr. Sufiyan Mohammed El Assouli, Dr. Abdel-Hakim Kelany, and Dr. Wafa Makki Nichols, members, department of Medical Biology, College of Medicine, King Abdulaziz University, Jeddah. The first edition

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New Arrival of the book has been published by Khawarism Academy, Jeddah, 2008. ISBN: 978-9960-58-998-5, L D No 1428/8007.

The Lab manual has many important distinguishing features of its own. Tailor made for use in one semester introductory biology course, it emphasizes investigatory, quantitative and comparative approaches to study human medical biology and strikes a balance between experimental, observational and comparative activities. Each chapter is coherent, organized and distinguished; beginning with comprehensive definitions, useful vocabulary terms and a short description of basic concepts. Objectives of each exercise, preceding text instill clarity in the mind of students with respect to what they are going to achieve through it. The language is lucid with a mix of standard pictures and illustrations. The strongest point is the exercises designed to improve intellectual thinking and clarity. New teaching elements added, will keep the students busy. Thus, new critical thinking and lab summary questions are main strength of the book. The detailed list of contents at the start of the book makes the chapters easily accessible. Considering the salient features of the Lab manual, it is hoped that it will continue to play an important role in understanding the finer aspects of human and medical biology.

The manual is equally relevant for home study for the students as it seeks to introduce them the general elements of human medical biology in a lucid and comprehensible style and help to come prepared in the labs to venture into the diversities of the various levels of biological organization. It will improve their understanding of the organisms and functions they are investigating.

The Editor and the authors deserve complement and appreciation for dealing so diligently with their attempts. The clarity, accuracy and completeness of the finished text is commendable. The Lab Manual is an invaluable analysis of the principles of human medical biology prepared with meticulous attention.