ELECTRON MICROSCOPY OF ANCIENT MICROFOSSILS

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Description:

Prof. Xiao's current research focuses on the biological evolution and environmental changes in the Proterozoic Eon (2500 to 543 million years ago). He has been working on some of the most important and exquisitely preserved microfossils from the ca. 600-million-year-old Doushantuo Formation in South China. These microfossils include multicellular red algae and animal embryos at successive cleaving stages. In addition, he has been working on single-celled eukaryotes from much older, about 1400-million-year-old, deposits from North China.

Traditional research tools, including acidification, thin section, light microscopy, and scanning electron microscopy (SEM), have been applied in the study of these ancient fossils. Prof. Xiao is currently working with scientists from the Tulane University Coordinated Instrumentation Facility to conduct transmitted electron microscopy (TEM) analysis of these fossils. It is expected that the TEM tool can resolve nano-scale ultrastructures of these ancient microfossils in order to address issues related to their biological affinity and fossilization processes.

LAMP students will participate in the sample processing, SEM, and TEM work together with Prof. Xiao.

Objectives:

LAMP participants will learn basic knowledge about the fossil record of early multicellular eukaryotes and animals. They will appreciate the great magnitude of geological and evolutionary time. They will also learn basic paleontological techniques including thin sectioning and acid maceration (acetic, hydrochloric, and hydrofluoric acid), as well as various microscopic techniques (light, scanning electron, and transmitted electron microscopes). Above all, it is fun to look at microfossils under the microscope.

Prerequisites:

Patient and meticulous. Preliminary training in biology and geology would also help.

SHAPE EVOLUTION IN FISHES OF THE SUBFAMILY ICTIOBINAE

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Description:

Fishes of the subfamily Ictiobinae are large, bottom feeding fishes commonly referred to as buffalo fish and carp suckers. They are native to large rivers and lakes in eastern North America (inclusive of Mexico). Seven extant species are currently recognized in the two genera: *Carpiodes* and *Ictiobus*. However, most ichthyologists consider the group to be much more diverse, with each of the current species representing complexes of two to many species. The seven currently recognized ictiobine species are easily distinguished on the basis of shape characteristics such as proportions of the head and body, size and shape of the eye, length of the snout, position of the nostrils, size and height of the fins, and size and position of the mouth. Considerable shape variation also exists within species, and many ichthyologists consider this variation to be taxonomically informative.

In this project, students will use modern, computer-based methods of morphometrics (shape analysis) to quantify shape differences within current ictiobine species complexes and to interpret this information taxonomically. Data on overall shape and shape-change during growth will be gathered for different populations of select ictiobine species using an image-analysis system. Analysis of the images will reveal patterns of shape evolution and may confirm the existence of new species within the ranges of currently recognized ictiobine species. (For additional background on this project, please visit the web site: http://www.museum.tulane.edu/ictiobin).

Objectives:

1) During the 10-week period, participants will gain experience with:
2) Formulating and testing scientific hypotheses;
3) Modern methods of morphometrics and systematic ichthyology;
4) Computer analysis of data, scientific report writing and presentation of results.

Prerequisites:

Completion of sophomore year, GPA of 3.00 or higher, aptitude and motivation for advanced study in fish biology.

RESEARCH AND DEVELOPMENT OF PERMEABILITY TESTING DEVICE FOR HYDRATED SOFT TISSUE

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Description:

One of important physical characteristics in biological soft tissues is permeability. The permeability is a quantitative measure to determine how easily a fluid can flow through the tissue matrix. The permeability provides us with critical information about the diffusive transport of nutrients and metabolites to maintain the biology of the tissue, as well as about the biomechanics of the soft tissue. The experimental measurement of the permeability of hard tissue has been well developed. However, the permeability of compliant soft tissue has not been very successful, partly because of the technical difficulties of handling the softness of the tissue. The goal of the project is to develop a reliable permeability device which can be used to measure the permeability of various hydrated soft tissues, such as cartilage, tendon, ligament, muscle, and brain.

Objectives:

The student will work with a faculty advisor and graduate students in the lab to develop a conceptual design of a permeability device.

Prerequisites or Experience Required:

Mechanical engineering or biomedical engineering (or chemical engineering) background is required.

FIBER REINFORCED MATERIAL CHARACTERIZATION FOR MILITARY BRIDGE STRENGTHENING TECHNIQUES

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Description:

A new method of strengthening reinforced concrete beams has been developed by the faculty investigator and large scale beam specimens are being tested at Tulane University to further understand and develop the method for military purposes. The LAMP student will conduct laboratory testing of fiber reinforced polymeric materials and perform analysis on the data gathered. The laboratory testing will include testing for tensile strength, bearing strength, and clamped bearing strength. The student will also have the opportunity to assist graduate students in other laboratory testing.

Objectives:

The primary objective of the LAMP research will be to fully characterize the materials to be used by the graduate student researchers conducting the strengthening of the large scale beam specimens. The results of the materials testing will be used to design experiments during the next academic year. The secondary objective is to develop a report documenting the findings of the project.

Prerequisites:

Proficiency with Microsoft Excel is required. Strong math, science, and analytical abilities are preferred. A strong interest in the Tulane University graduate program in Civil Engineering is also preferred.

NANO TECHNOLOGY: MOLECULAR ELECTRONICS AND NANO ELECTRONIC FOR QUANTUM COMPUTERS

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Description:

Primary direction of progress of 'information technology' has been towards miniaturization of devices, increased speed and reduced power consumption. To a certain degree these features are interconnected, in general, larger the size, slower the speed, and higher the power consumption. The trend of advancement of solid-state circuits is forcing the device level measurements at nano meter scale, where keeping the basic switching property of the device becomes difficult. The direction of this research is to find alternate device options, which will show similar switching property of solid-state devices at smaller scale with higher speed and lesser power dissipation.

Computer size and processor size has been shrinking ever since the invention of transistors at bell labs. The progress of the information technology has been attributed by shrinking size of solid-state transistors and processors and consumer electronic chips made up of those transistors. For long despite of various negative and positive predictions moore's law has been able to predict successfully the advancement of information technology.

Knowledge derived from the fields of MEMS and LCD predicted the possibility of computational devices made up of molecules at nano meter scale. At this time, when computational electronics is facing the hardest challenge to maintain the speed of advancement, people are putting more intense effort is to find alternative devices for computation. This includes sensors, actuators and switching devices. Solid-state devices have hit the rock bottom of miniaturization. To meet the demand of speed and low power, alternatives to solid semi conductors have to be searched in the range of nano meter scale feature size. Nano technology is already a proven technology for LCD but it is yet to prove its worth for computational applications. The ultimate objective of computational industry is quantum computing, which is very immature at this stage, molecular electronics is the next step in miniaturization after MEMS and substitute of MEMS in some cases until quantum computing takes over.

Nano technology has been used widely in liquid crystal display (LCD), but now nano technology is being seriously considered for replacing current technology in mechanical, electrical and computational industry. In the computational and related industries, widely used devices are light emitting diodes (LED), organic light emitting diode (OLED), Diodes, field effect transistors (FET), bipolar junction transistors (BJT). Diodes, BJTs and FETs have generic characteristic.

This characteristic is to influence the amplitude of either current or voltage in one terminal by controlling the voltage or current in other terminal. This characteristic can be approximated to switching or amplification characteristic by imposing the device under suitable conditions. Development of molecular nano electronics using non solid-state semi conductors depends on finding molecular devices, whose characteristics can be approximated to the switching and amplification property by imposing suitable conditions on the molecule.

The proposed project will provide student a great deal of opportunity to work on a project involving lots of exciting aspects of nanotechnology.

Objective: To provide an exciting opportunity to student to work in frontier area of nano technology and its numerous applications including quantum computers.

Prerequisites:

None

LIGHT EMITTING DEVICES THROUGH ORGANIC CHEMISTRY

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Description:

Flat panel displays (in billboards, TV, computer monitors, etc.) are attractive, since they represent the state-of-the-art in display technology. My group is interested in implementing a novel approach to the design and syntheses of macromolecules that will have the potential as efficient light emitting components of these displays.

Objectives:

Students will work at the interface of chemistry and other sciences, such as biology and material science. Students participating in this program in my lab will gain extensive synthetic expertise in organic chemistry. Students will also gain hands-on experience with characterization techniques such as NMR, IR, UV-Visible and fluorescence spectroscopy. In addition, the students will acquire the ability to interpret mass spectrometry and other materials data.

Prerequisites:

Completion of chemistry courses through organic chemistry is required along with motivation to learn new aspects of science.

THE CELLULAR MEMORY OF TRANSCRIPTIONAL STATES

Mentor: Arthur J. Lustig, Ph.D.
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Description:

The long-term goal of studies in my laboratory is to understand the multiple functions of telomeres using the yeast *Saccharomyces cerevisiae* as a model eukaryotic system. Telomeres, the protein-DNA structures present at the termini of chromosomes, serve essential functions involved both in the initiation of oncogenesis and in the aging process. One of these functions is the ability of telomeres to confer transcriptionally quiescent states onto adjacent genes. This process, termed telomeric silencing, is used as a measure of the influence of telomere structure on adjacent genes.

The proposed project is part of our ongoing efforts that use telomeric silencing as a model system for cellular memory. Cellular memory, the ability of a cell to perpetuate a specific transcription state through multiple generations, is a central characteristic of variegation and differentiation. We have recently discovered a relationship between cellular memory and alterations in telomere structure. On the basis of these studies, we have proposed a structural switch in the telomere that triggers a molecular communication between telomeric and adjacent sequences.

Objectives:

The major goal of the student's project will be to investigate this potential switch using novel methods, developed in our laboratory, that measure telomeric chromatin states through accessibility of the telomere to DNA modifying agents *in vivo*. Specifically, the student will use this accessibility assay in specific mutants that influence telomeric silencing. These studies should lead to a better understanding of the components of the telomere that are involved in the switching of transcriptional states at the telomere.

Prerequisites:

General Biology course, Genetics course and laboratory familiarity.

TRANSPORT PROPERTIES OF MCF-7 CELLS

Mentor: Mouhamed Awayda
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Description:

The MCF-7 cell line has been utilized to study the physiology and pathology of human epithelial breast carcinomas. The effects of antiestrogens, tumor promoters, and other chemotherapeutic agents on cell proliferation cell cycle, and viability have been extensively characterized. The effects of these agents on the cellular electrophysiology are not fully understood, however. Ion channel activity is related to cell function and viability and these agents are known to affect the activity of a variety of ion channels in a multitude of systems, including MCF-7 cells. Therefore, a better understanding of tumor promoting or tumor inhibiting agents is paramount to improving breast cancer therapy. Before the effects of these agents on the electrophysiological properties of breast cancer cells can be detailed, these cells must be studied under growth conditions that closely mimic those observed in vivo.

Objectives:

The LAMP student will assist in the culture of MCF-7 cells under conditions that allow the formation of distinct apical and basolateral membranes. The transepithelial transport properties of the cells will be characterized and both the short and long term effects of estrogens, antiestrogens, and adriamycin on the transport properties will be determined. The completion of the study will provide a better understanding of the actions of the therapeutic agents on the MCF-7 cells.

Prerequisites:

The student should have a background in biology, chemistry, and physics.

MECHANISMS OF DRUG RESISTANCE IN AN EPITHELIAL BREAST CARCINOMA CELL MODEL

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Description:

Our laboratory is currently investigating the mechanisms by which cells develop resistance to the continued presence of chemotherapeutics. Our hypothesis is that drug accumulation is indirectly controlled by drug efflux pumps rather than what is conventionally accepted as a direct link between drug efflux transporters and drug accumulation. This is supported by the observation that drug resistance is conferred to a multitude of very different substrates and it is conceptually difficult to visualize how certain proteins (e.g., P-glycoprotein) can actively transport over one hundred unrelated compounds.

Preliminary data from our laboratory supports this conclusion. Changes of the intracellular voltage and/or pH were found to alter drug accumulation and efflux. This occurred in a cell line that is essentially devoid of the drug efflux protein (P-glycoprotein).

Objective:

The focus of future research will be to better define the regulation of drug accumulation by the intracellular milieu, in addition to transfection studies with P-glycoprotein to further demonstrate that this protein indirectly affects drug efflux.

Prerequisites:

None

SYNTHESIS OF MATERIALS FOR ELECTROLUMINESCENCE APPLICATIONS

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Description:

Organic light emitting diodes and electroluminescent organics have attracted considerable interest in the recent past because of their potential applications in display devices. Various derivatives of poly-phenylene vinylene appear to show promise because of their excellent luminescence characteristics. Recently we have been working on the synthesis of phenylene-vinylene units containing nitrogen heterocyclic ligands that can be polymerized by coordination of the nitrogen heterocycle to metal ions (i.e. Zn^{2+}, Fe^{2+}, Ru^{2+}, Ir^{3+}). The luminescence of the derivatives we have made thus far spans the green and red portions of the spectrum. Our need is to develop additional derivatives that exhibit blue emission.

Objective:

Make electroluminescent metal organic compounds that emit blue light. Synthesize nitrogen heterocyclic molecules and metal complexes of the molecules. Examine the luminescence of the molecules. Work on the construction of electroluminescent cells.

Prerequisites:

A student with a background in Organic Chemistry is preferred. The student will spend most of his/her time doing synthesis of organic and metal organic compounds. Students will gain experience in synthetic methodology, NMR spectroscopy and fluorescence spectroscopy.

MECHANISMS OF GENETIC HYPERTENSION

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Description:

This project utilizes molecular biological as well as electrophysiological techniques to study gain of function mutations of the epithelial Na+ channel. This channel and mutations thereof are implicated in multiple forms of genetic hyper- and hypo-tension. These mutations lead to changes of channel activity and ultimately salt and water reabsorption. We have previously identified multiple channel domains that lead to changes of channel activity. This project deals with a better characterization of the molecular mechanisms of these domains and how they regulate channel function and ultimately blood volume and pressure.

Prerequisites:

This project requires a high degree of dedication and has the potential for paid/volunteer research during the academic year. Qualifications include prior laboratory experience, good grasp of Physiology/Cell Biology and most of all dedication to complete this potentially rewarding work.

ORGANOMETALLIC CATALYSIS AND NANOTECHNOLOGY

Mentor: Mark Fink
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Description:

Students will be involved in the synthesis and characterization of organometallic compounds which are precursors to homogeneous and heterogeneous catalysts.

Objectives:

Students will learn skills in the synthesis and isolation of air-sensitive organometallic compounds. They will also learn characterization techniques including NMR, mass spectrometry, IR, and x-ray crystallography. In addition the incorporation of molecular complexes into nano-phased materials will be explored.

Prerequisites:

Students should have completed Chemistry course work through Organic Chemistry and possess good laboratory skills.

REGULATION OF KIDNEY FUNCTION IN RELATION TO FILTRATION RATE AND HYPERTENSION

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Description:

The emphasis of our research focus on elucidating the role of the hormone, angiotensin II (Ang II), in angiotensin-induced hypertension. As is the case with any biological system, an abnormal condition, in this case hypertension, is attributed to a suite of factors and influences. Therefore our research uses angiotensin as a starting point and looks at how angiotensin II influences kidney function and ultimately induces hypertension as well as how other hormones or conditions affect angiotensin's role in potentiating hypertension. For example, the cardiovascular and nervous systems as well as the adrenal glands, to name a few, are all influenced by or exert an influence on the role angiotensin plays in hypertension and normal kidney function. We use a number of advanced techniques in molecular and cellular biology and genetics such as transgenic mouse models and immunohistochemistry as well as well-established, yet more conventional methodologies to addresses particular questions of renal physiology and hypertension.

Objectives:

Specifically, one area of research that has received little attention, but warrants further investigation is the interaction of the pituitary hormone, vasopressin (AVP), on angiotensin II. Most of the current data shows that angiotensin II is a potent stimulant of AVP release under both stress and water deprived conditions. Moreover, AVP possess a pressor effect on the cardiovascular system that may be responsible for increasing filtration rate. However, the role AVP may have on the kidneys, especially in promoting angiotensin-induced hypertension has yet to be examined in detail. Therefore, we propose to infuse different groups of rats with different doses of AVP once the animals have been treated with angiotensin II in order to induce a chronic state of hypertension. The recent discovery of a dual AVP/AngII receptor in the kidney suggests that AVP will potentiate angiotensin-induced hypertension. The objectives of the proposed study are to examine the role AVP plays on angiotensin II release and content in the kidney and whether or not it potentiates hypertension. The study will provide students with opportunities to 1) handle animals, 2) implant mini-osmotic pumps for hormone delivery, 3) assist in tissue preparation for molecular and immunohistochemical techniques, 4) obtain daily physiological and metabolic measurements, 5) prepare blood samples for various biochemical and hormonal analyses and 6) participate in data analysis.

Prerequisites:

Because the postdoctoral fellows in the lab primarily conduct these studies, the students do not require any prerequisites to participate in the lab. All techniques and methodologies will be learned first-hand via on the job training. Students will be expected to maintain a lab notebook containing detailed descriptions of methods and techniques used. Students should also express a desire to obtain advanced degrees in biology with an interest in research, preferably in biomedical science.

ROLES OF HIPPOCAMPAL/NEOSTRIATAL SYSTEMS IN MULTIPLE FORMS OF MEMORY

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Description:

The broad research goal of this project is to systematically define relationships between two brain regions known to support different types of memory among mammalian species: the neostriatum and the hippocampal formation. Although the roles of these two systems have been dissociated experimentally, the extent to which they function independently, cooperatively, competitively, or in temporal sequence is not known currently. Moreover, the time courses and cellular mechanisms of memory formation supported by these two systems are not understood well. Memory formation is accompanied by changes among some neurons involved in, or influenced by, information processing. Experiments conducted in this laboratory will test hypotheses that these changes are memory- and brain region-specific: neostriatal activation supports response, nonspatial, and procedural memory, whereas hippocampal activation supports place, spatial, and declarative memory. The current experiments employ two primary research strategies. The first is to use behavioral manipulations to induce learning-related changes in cellular mechanisms of memory formation and to quantify those changes within the neostriatum and hippocampal formation. The second research strategy is to test the effects of highly selective protein inhibition on acquisition and retention of neostriatal- and hippocampal-dependent memory. By combining these research strategies, we intend to elucidate the relationships between the hippocampal formation and neostriatum during multiple types of memory formation at the behavioral, brain systems, and neuronal levels of analyses.

Objectives:

Undergraduate student interns will work closely with graduate students on continuing experiments. Opportunities exist to learn and practice methods of behavioral and cognitive assessment in rodents as well as other techniques including stereotaxic surgery, western blotting, immunocytochemistry, design and use of oligodeoxynucleotides for selective protein suppression, and data analysis.

Prerequisites:

Some coursework and background in neuroscience, biological psychology, or chemistry.

ASSESSMENT OF THE IMPACT OF TOXIC CHEMICALS ON HUMANS AND THE ENVIRONMENT

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Description:

This ten-week summer internship will train two undergraduate students (LAMP Participants) about the Assessment of the impact of Toxic Chemicals on Humans and the Environment. Participants will be assisted to design experiments about evaluation of toxicity testing of organic and inorganic environmental xenobiotic. They will be guided in conducting these experiments in a laboratory setting by exposing aquatic organisms to different concentrations of toxicants. They will learn how to use analytical lab equipment and determine the levels of these contaminants in tissues of exposed animals. They will be trained on monitoring selected water parameters. These include dissolved oxygen, Ph, temperature, alkalinity and hardness. Finally, students are expected to learn and apply statistical methods to the interpretation of their data. Participants will write a final report and present it to a group of faculty and students.

Objectives:

Upon the completion of the Internship, students will be able to:

1) Design and implement a toxicity evaluation experiment.
2) Use statistical models to analyze and interpret the experimental results.
3) Use analytical lab equipment to measure the toxicant levels in abiotic and biotic samples.
4) Assess the risk of study chemicals to humans and the environment using available risk assessment models.
5) Write a scientific report and present it to a group of scientists.

Prerequisites:

A basic knowledge of biology, math and chemistry is much desirable. Motivation and commitment are extremely important.

NEW MEDICINES FOR THE TREATMENT OF CHRONIC PAIN

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Description:

Analgesic drugs like aspirin, ibuprofen, and Tylenol effectively treat acute pain, such as minor cuts, bruises, and headaches. But for unknown reasons, these drugs do not work as well when the pain is long-lasting, such as with arthritis or lower back pain. Why not? Our medical sciences laboratory is studying how chemical changes in the spinal cord and brain might lead to chronic pain. Our approach is to study the body's natural pain-killers, including the endorphins (thought to cause the runner's "high") and neuropeptide Y. Our laboratory is testing hypotheses that might determine just how these natural pain killers work. Our work may lead to the development of more effective drugs for the treatment of chronic pain.

Objectives:

1) Complete a pharmacology (drug research) experiment in small animals.
2) Analyze neurons in the brain or spinal cord after dissection.
3) Learn and utilize some simple molecular biological techniques.

Prerequisites:

This project is ideal for students considering a profession in the medical sciences. Requires some biological laboratory experience, such as mammalian dissection. Laboratory experience in chemistry a plus.

TRANSCRIPTIONAL FUSION STUDIES OF THE *DNR* PROMOTER IN *PSEUDOMONAS AERUGINOSA*

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Description:

Pseudomonas aeruginosa is a Gram negative opportunistic pathogen capable of many different types of infection. *P. aeruginosa* is capable of both acute and chronic infections. Acute infection sites may be ocular, aural, epithelial or blood-borne and are usually the result of a breach in the primary host defense system. The most notorious chronic infection caused by *P. aeruginosa* is located in the respiratory tracts of Cystic Fibrosis (CF) patients. *P. aeruginosa* CF isolates are characterized by an alginate overproducing phenotype described as mucoid. The main regulatory mechanism for the conversion of *P. aeruginosa* to a mucoid phenotype involves activation of the stress sigma factor AlgU (AlgT) through acquired mutations in the *mucA* gene, which encodes an anti-sigma factor. Another regulatory factor that is required for the expression of alginate is the response regulator AlgR. AlgR also controls an apparently unrelated process of twitching motility in *P. aeruginosa*. The mechanism for this is currently unknown. Additionally, we have recently shown that AlgR is required for *P. aeruginosa* virulence in a murine septicemia infection model. The previous roles for AlgR described all indicate that it is acting as a transcriptional activator of the processes described.

Recently, evidence indicates that *P. aeruginosa* may be utilizing anaerobic metabolism as one of the mechanisms to maintain a chronic infection in the CF lung environment. Two transcriptional regulators in *P. aeruginosa*, ANR and DNR have been shown necessary for denitrification, a process that occurs in an environment of low oxygen concentration. Our preliminary data using Affymetrix GeneChip technology indicate that AlgR is repressing anaerobic metabolism genes, as well as the transcriptional regulator *dnr* under mid-logarithmic growth and aerobic conditions.

Transcriptional fusion studies will determine if AlgR is directly or indirectly controlling transcription of the *dnr* gene.

Objective:

Measure the *dnr* promoter activity in *P. aeruginosa* under aerobic and anaerobic growth conditions.

Prerequisites:

No experience is required.

MOLECULAR MECHANISM OF *PSEUDOMONAS AERUGINOSA* PATHOGENICITY

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Description:

Pseudomonas aeruginosa is a Gram negative opportunistic pathogen. It is the cause of a multitude of infections such as acute septicemia in immunocompromised patients and chronic pneumonia in cystic fibrosis (CF) patients. *Ps. aeruginosa* also causes frequent infections in patients that have undergone cancer treatment, trauma or burns. The long- term goal of this laboratory is to understand the molecular mechanisms *Ps. aeruginosa* pathogenicity. Hydrogen cyanide is produced by clinical isolates of *Pseudomonas aeruginosa* from cystic fibrosis patients.

Objective:

The goal of this project is the make a deletion of the hydrogen cyanide gene *hcnA* in the laboratory strain of *Pseudomonas aeruginosa* and assay for hydrogen cyanide production from the laboratory strains and clinical isolates of *Pseudomonas aeruginosa*.

Prerequisite:

No experience is required.

A NOVEL METHOD OF DESALINATION OF SEA WATER

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Description:

We are working on a method for seawater desalination using the technology of clathrate hydrates. These are ice-like structures formed from water and gas (see the web site http://www.netl.doe.gov/scng/hydrate/ for some neat information on hydrates) and are extensively found in the Earth's subsurface especially under the sea floor and in the arctic regions. But we make hydrates in the laboratory!

Objectives:

Since ice is essentially pure water, our objective is to make these ice-like structures from seawater and thus remove the salt. If successful, this project will have an enormous impact on the world's water supply.

Prerequisites:

A strong curiosity for science and the desire to get your hands dirty.

NON-DESTRUCTIVE TEST METHODS FOR THE EVALUATION OF STRUCTURES

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Description:

The research involves an ongoing project at Tulane University that is concerned with the non-destructive evaluation of structural components. The transportation infrastructure is decaying at an alarming rate, and the Federal Highway Administration estimates that 30 percent of all bridges in this nation are structurally deficient. Several new materials have been proposed for use in highway bridges. These include fiber reinforced polymers, high strength steels and high performance concrete. The research at Tulane concerns the durability of all construction materials, but has a specific focus on fiber reinforced polymers. These materials have a very high strength to weight ratio and are resistant to fatigue and most chemical environments. In addition, they will not corrode in the presence of moisture.

Acoustic emission monitoring is one way in which structures can be monitored to determine their long-term suitability in the constructed environment. As damage takes place within a structure, stress waves are generated that can be detected on the surface of a structure with a piezo-electric crystal. The interpretation of these captured waves is then used to determine the level damage that has occurred internally to the structure.

Objectives:

The acoustic emission technique will be applied to fiber reinforced polymer specimens. The specimens will be loaded under a controlled loading environment to determine the nature of the acoustic emission activity. The emissions will be captured and analyzed. Specimens to be tested are small scale sections (1' x 1' x 6' long) of fiber reinforced polymer bridge decks. The objective of the project is to determine the suitability of these newer materials for long-term use in the transportation infrastructure.

Prerequisites or experience required:

No prerequisites or experience is required. An interest in structural or materials engineering will be helpful.

INHIBITION OF CYTOCHROME P450 BY ACETYLENE COMPOUNDS

Mentor: Nancy Eddy Hopkins, Ph.D.
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Description:

Cytochrome P450 (CYP) enzymes are an important super family of enzymes. These enzymes are involved in the production and destruction of steroid hormones, in the cytokine response, in the metabolism of foreign compounds and drugs, and in carcinogenesis. Our laboratory is studying possible inhibitors of several CYP enzymes.

The compounds we are studying have been synthesized by Dr. William Alworth's laboratory at Tulane and Dr. Maryam Foroozesh's laboratory at Xavier. These compounds are acetylene derivatives of known substrates of several important CYP enzymes. We are seeking to find compounds that inhibit by mechanism-based inhibition. In this type of inhibition, the enzyme metabolizes the inhibitor to its active form. The activated inhibitor then covalently binds to the enzyme and destroys it. Important implications of this research include developing anticarcinogens and developing cancer drugs.

Objectives:

The objects of this project include testing a group of recently synthesized adamantyl and naphthyl acetylenes to determine if they are inhibitors of CYP 1A1, 1A2 and 2B1 *in vitro*. We will be using commercial available human enzymes produced in culture in a fluorescence assay with a selective resorufin substrate. We will screen the compounds to determine which compounds are inhibitors. Using kinetic analysis methods we will determine the type of inhibition and the K_I and k_i kinetic inhibition parameters. This work will identify promising compounds to test further in cell culture or animal models and will give us insight to design better inhibitors.

Prerequisites:

Students who have completed organic chemistry and introductory biology will be able to carry out this work. Knowledge of cell biology and biochemistry are useful but not necessary.

BIOINFORMATICS

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Overview:

The major objectives of this project are: (1) development of a local database; (2) analysis of data contained in the database; (3) and visualization.

1. Development and Maintenance of Databases
The simplest tasks used in bioinformatics concern the creation and maintenance of databases of biological information. Nucleic acid sequences (and the protein sequences derived from them) comprise the majority of such databases. While the storage and organization of millions of nucleotides is far from trivial, designing a database and developing an interface whereby researchers can both access existing information and submit new entries is only the beginning. Further, there is a need to induce maximum amount of intelligence in the controlling software so that the storage and maintenance tasks can be performed autonomously with minimal human intervention.

2. Analysis
The power of a database comes not from the collection of information, but in its analysis. A sequence of DNA does not necessarily constitute a gene. It may constitute only a fragment of a gene or alternatively, it may contain several genes. This task involves the analysis of sequence information and it involves the following sub-tasks:

- Finding the genes in the DNA sequences of various organisms
- Developing methods to predict the structure and/or function of newly discovered proteins and structural RNA sequences.
- Clustering protein sequences into families of related sequences and the development of protein models.
- Aligning similar proteins and generating phylogenetic trees to examine evolutionary relationships.

3. Visualization
Visualization is used to enhance analysis, pattern discovery, and data mining. Visual tasks include statistical displays, as well as graphical modeling of biological entities (e.g., genes, proteins, organs).

Prerequisites

Computer Science: data structures (CPSC 118 at Tulane)