From: [redacted]
Sent: Monday, March 04, 2019 2:44 PM EST
To: [redacted]
Subject: Question - Int Partner related

How does TJ purchase text books? I have no idea and realize I shouldn't assume its all through one central spot, or many different spots.

Do you have time to speak in person on WED on some items that Shirble has asked me about (nothing odd, just stuff I am not confident in). Let me know if you do and when you could!

[redacted]
Thomas Jefferson High School for Science and Technology
Partnership Fund // The Campaign for TJ
Manager, Outreach and Partnerships
703-750-8316 (office)
[redacted]
tjpartnershipfund.org

From: [redacted]
Sent: Wednesday, March 13, 2019 11:58 AM EDT
To: [redacted]
CC: [redacted]
Subject: Fwd: Teaching IBET - Design & Tech
Attachment(s): "Neuroscience Research Lab Overview.docx"

Any ideas about how to prepare teachers to teach Tech 9 style class?

Begin forwarded message:

From: [redacted]
Subject: Teaching IBET - Design & Tech
Date: March 13, 2019 at 11:57:00 AM EDT
To: [redacted]

Hi [redacted],

Shirble is asking how best to prepare teachers to teach the Design & Tech part of IBET.

I know it's a course that TJ designed and therefore there is no textbook.

Is there any written documentation about it like what you prepared for us about your lab (see attached as reminder)? If not, do you think we (the TJPF) could pay one or more Design/Tech teacher(s) to prepare something like this that we could keep and use with International Partners? We would need it soon (not wait until the summer) – probably within a month.

Thoughts? Can I reach out to the Design/Tech teachers? Would you like to prep them?

[redacted]
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Table of Contents

Curricular Pathways into Neuroscience Lab

Biological Pathway

Required Courses

1. 9th Grade IBET Biology
2. 10th Grade AP Biology
3. 11th Grade Neurobiology (Sem)

Suggested Courses

- Analog Electronics (Sem)
- Digital Electronics (Sem)
- DNA Science I and II (Sem)
- AP BC Calculus

Computer Science Pathway

Required Courses

1. 9th Grade Foundations of Computer Science
2. 10th Grade AP Computer Science
3. 11th Grade Artificial Intelligence I and II (Sem)
4. 10th or 11th Grade AP BC Calculus

Suggested Courses

- Neurobiology (Sem)
- Analog Electronics (Sem)
- Digital Electronics (Sem)

Engineering Pathway

Required Courses

1. 9th Grade IBET Technology
2. 10th or 11th Grade Robotics and Automation I and II (Sem)
3. 10th or 11th Grade AP BC Calculus

Suggested Courses

- Neurobiology (Sem)
- Analog Electronics (Sem)
- Digital Electronics (Sem)
- Prototyping I and II (Sem)

Major Research Themes of the Neuroscience Laboratory

Behavioral Neuroscience

Behavioral neuroscience is the study of how a person's brain influences that person's behavior. This leads us to explore topics like Learning and Memory, Memory Loss, and Dementia. We also explore Sensorimotor Processing, which gives us insight into how the brain functions to help us experience the world through our senses.

The distinguishing characteristic of a behavioral neuroscience experiment is that either the independent variable of the experiment is biological, or some dependent variable is biological. In other words, the nervous system of the organism under study is permanently or temporarily altered, or some aspect of the nervous system is measured (usually to be related to a behavioral variable).

Sample Projects

- The Effect of Memory Inhibition and Chemoreception Inhibition on Crayfish Aggression
- Quantification of Empathic Response to Observed Pain in Others via Mu Rhythm Suppression

Cellular and Molecular Neuroscience

Molecular neuroscience is a branch of neuroscience that observes concepts in molecular biology applied to the nervous systems of animals. The scope of this subject covers topics such as molecular neuroanatomy, mechanisms of molecular signaling in the nervous system, the effects of genetics and epigenetics on neuronal development, and the molecular basis for neuroplasticity and neurodegenerative diseases. As with molecular biology, molecular neuroscience is a relatively new field that is considerably dynamic.

Sample Projects

- Investigating the Effect of Varying Calcium Concentrations on an In Vitro Model of Stroke Induced Epilepsy
- Serotonin-Mediated Reversal of Cellular Degeneration due to α-Synuclein Aggregation

Brain-Machine Interface/Computational Neuroscience

A brain–computer interface (BCI), sometimes called a neural-control interface (NCI), mind-machine interface(MMI), direct neural interface (DNI), or brain–machine interface (BMI), is a direct communication pathway between an enhanced or wired brain and an external device. The field of BCI research and development has since focused primarily on neuroprosthetics applications that aim at restoring damaged hearing, sight and movement. Thanks to the remarkable cortical plasticity of the brain, the brain like natural sensor or effector channels can after adaptation, handle signals from implanted prostheses.

Computational neuroscience is a branch of neuroscience, which employs mathematical models, theoretical analysis, and abstractions of the brain to understand the principles that govern the development, structure, information processing, physiology and cognitive abilities of the nervous system.

Sample Projects

- Analysis and Use of Mu Rhythms to Establish Flight Drone Control in 3-Dimensional Space
- Controlling a Robotic Arm Using an Electroencephalograph and OpenViBE software
- Simulating Populations of Theta Neurons with Bivariate Bimodal Cauchy Distributions of Excitability and Coupling Strength Using Mean Field Reduction

Selection of Students for Laboratory

In December of their 11th grade year, students submit applications to the research lab. Their application consists of a smaller scale version of their final proposal. The purpose of this application is to judge the students on two aspects. 1) The feasibility of the proposed project including an initial literature review to justify their work, and 2) the background knowledge of the students as matched against the proposed project idea.

Selection of Research Projects

During the first weeks of each semester, the students formally present their research project to the lab director(s) in a face-to-face meeting. The students explain their projects to the lab director, present background literature to justify their proposed projects, explain any safety hazards or issues surrounding human subjects. During this meeting, the Lab Director will make suggested changes, reduce or expand the scope of the project, adjust independent or dependent variables, or suggest a different project. All projects are then finalized within the first two weeks of the research semester.

Evaluation of Research Projects

Weekly Lab Meetings

Each week, all students in the lab sit around our large meeting room table and take turns reporting on their progress. They have to answer three questions 1) What did you accomplish last week, 2) What are your goals for this week, 3) Are there any specific difficulties they are having that they would like to discuss as a group. While students are giving their mini-presentations I score their responses to these three questions as an indicator of their weekly experimental progress.

Maintenance of Research Notebooks

Each research group is required to maintain a written record of their daily activities. I provide a hardbound research notebook to each group, and during our weekly lab meetings I have the students turn in their notebook for my inspection. Guidelines for what should be written in the notebooks are provided in the Neuroscience Research Lab Student Handbook.

Research Proposal

The research proposal is intended to provide a framework for student research projects. It should describe the research topic area (with background references), the specific problem being addressed and the methodology used. It should also Describe the significance of the project, relative to the scientific community and/or within the Neuroscience lab. In particular, if the project continues work done by previous groups the proposal should provide a short description of past goals, methods, and results.

Protocols/Methods of Research

One of the most important aspects of scientific work is carefully recording your experimental methods. As such, each research group is responsible for contributing detailed experimental protocols to our Protocol Library. Protocols are assessed based on guidelines provided in the Neuroscience Research Lab Student Handbook, which emphasizes clarity and completeness of experimental processes.

Research Paper

At the conclusion of each semester all research groups must complete a formal research paper. The structure of the paper follows the submission guidelines of the Society for Neuroscience, the largest professional Neuroscience organization in the world. It follows the traditional structure of a Title Page with and Abstract, followed by sections for Introductions, Literature Review, Methods and Materials, Results, and finally Discussion and Analysis. The paper must be well referenced and contain useful figures and tables. Specific grading guidelines are provided in the Neuroscience Research Lab Student Handbook

Research Poster

Many of our students compete in local, regional, and national scientific competitions. Some students even present their work at regional and national professional meetings. A component of all of these is a research poster that provides an overview of students research question, their methodology, results, and conclusions. Students must design a poster and submit it by the end of the semester that accomplishes these high-level goals. Specific guidelines for what information should be included in a research poster, as well as the general organization of that information can be found in the Neuroscience Research Lab Student Handbook.

Research Presentation

At the conclusion of the school year, all seniors participate in our STEM Colloquium called TJStar. On this day all seniors present their research projects to the public in a formal scientific talk. To prepare for this day, all students must submit for assessment their PowerPoint slides for evaluation. Guidelines for how these talks should be structured can be found in the Neuroscience Research Lab Student Handbook

Core Equipment in Neuroscience Research Laboratory

General Use

- Microscopes, dissection and compound

- Fume Hoods
- Chemical Storage
- High Precision Digital Scale
- General Use Computers
- 4C General Refrigerator
- Data Analysis Software (MatLab, Mathematica, etc)
- UV/Vis spectrophotometer
- 3D Printer
- Crushed Iced Machine
- Standard Chemical Lab Glassware Supply
- Water De-ionizer
- Assorted Hand Tools
- Assorted Electrical Tools
- Personal Safety Equipment

Behavioral Projects

- Aquarium and associated supplies
- Video Cameras
- Electrical Signal Amplifiers and Data Recorders
- Data Acquisition Software (LabChart)

Cellular Molecular

- Cell Culture Hood
- Centrifuge
- Water Bath
- -20C Freezer
- Pipettes
- Electrical Signal Amplifiers and Data Recorders
- Data Acquisition Software (LabChart)
- Glass Electrode Puller
- Glass Electrode Holders
- Vibration Isolation Units
- Faraday Cage/Electromagnetic Wave Shielding
- Microelectrode Array
- Cell Culture Incubator
- CO2 for Incubation
- Fluoresce Microscope/Cell Visualizer

Brain-Machine Interface

- Electroencephalograph(s) [EEG]
- EEG Data Acquisition Software (OpenVibe, MatLab)
- Upgraded Computers with sufficient RAM and GPU for doing advanced Machine Learning.