**Equinox Program**

**Session 2**

**Course Title:** Neuroscience Honors

**Instructor:** Jennifer McQuade

**Teaching Assistant:** Adriana Prada

**Course Description**

Explore the complex systems of the human brain, drawing on the interdisciplinary principles of biology, chemistry, anatomy, physiology, and psychology. Topics include neural systems and behavior; the embryonic developments of the central and peripheral nervous systems; study of sensory and motor systems; changes in brain chemistry; aspects of learning and memory; and disorders of the nervous system.  In addition to lectures and discussions, participate in laboratory dissections and experiments.

**Essential Questions**

* How does the brain detect, process, and respond to information to produce the remarkable individuality of human action?
* Are mental processes localized to specific regions of the brain or do they represent emergent properties of the brain as an organ?
* What do genes contribute to behavior, and how is gene regulation in nerve cells regulated by developmental and learning processes?
* How does experience alter the way our brain processes subsequent events.
* How does the chemistry of the nervous system changes during physical activity and in some neurological diseases?

**Outcomes**

Upon successful completion of this course, students will:

* Be able to describe the anatomy of a neuron and the path of communication.
* Understand how neurons communicate with other cells at synapses.
* Be able to differentiate between the parts of the nervous system.
* Be able to identify and describe the different cells of the spinal cord, and cerebellum
* Distinguish between the biochemical functions of key neurotransmitters.
* Understand different neural pathologies such as depression, schizophrenia, and addiction.
* Understand the relationship between the sensory system, which intakes external information and the motor system that carries out a response.
* Understand how movement occurs.
* Be able to collect and report scientific data.
* Be able to read and understand peer reviewed scientific articles.

**Instructional Strategies**

Pre-assessment and classroom interactions will be used to establish the learning style, interests, and level of prior knowledge for each student. Reading, problem solving, paper writing, presentations and laboratory experience with biological materials will be the basic learning methods for this course. Independent study, classroom participation, group learning, and team projects will be supported. The differentiated structure will encompass a layered curriculum, flexible grouping, compacting, tiered instruction, interactive discussion, and games and activities. Student comprehension, synthesis and application will be assessed throughout the course based on completed assignments such as homework, lab reports, quizzes and tests

**Resources and Materials**

* **Books**
  + Ramachandran, V.S. (2011). The Tell-Tale Brain: A Neuroscientist’s Quest for What Makes Us Human. Norton & Company, Inc.; New York City, NY.
* **Web sites**
  + [www.mcquadesbioconnect.weebly.com](http://www.mcquadesbioconnect.weebly.com)
* **Other Media**
  + A Beautiful Mind
  + Theory of Everything
* **Materials**
  + Three-ring binder, calendar/daily planner, notebook for note-taking, loose-leaf paper, pencil, eraser, pen, and scientific calculator should be brought daily. Access to personal computer, printer, and digital camera are recommended.

**Student Assessment**

**Pre-Assessment**

Students will be evaluated on general biology concepts covered in an introductory biology course and on scientific reading and writing ability. The pre-assessment will consist of short answer and multiple choice questions.

**CTD Grading Scale**

A+ 100-97% A 96-93% A- 92-90%

B+ 89-87% B 86-83% B- 82-80%

C+ 79-77% C 76-73% C- 72-70%

D+ 69-67% D 66-63% D- 62-60%

F below 60%

**Breakdown of Final Grade**

10% Participation, 25% Homework, 25% Labwork/Presentation, 40% Tests/Quizzes

**Post-Assessment**

Students will be evaluated on topics in neuroscience covered in the course. Emphasis will be placed on understanding of major themes, neurological processes, and mechanisms of disease relating to the brain. Problem solving, scientific reading comprehension, oral and written communication will be reviewed. The post-assessment will consist of multiple choice, short answer questions, and problem solving.

**Daily Schedule**

*\*Note: This is a tentative schedule and may change based on the needs and interests of the students.*

| **Date** | **Topics** | **In-class Activities** | **Assignments/Assessments** |
| --- | --- | --- | --- |
| Monday  7/18 | * The scientific method * Learning, memory, and the brain * The anatomical organization of the nervous system | * AM: Pre-assessment; Introduction to syllabus; Lecture; TED Talk VS Ramachandran: 3 Clues to Understanding your Brain   The Tell Tale Brain   * PM - Modeling the nervous system, TED | The Tell Tal Brain-Chapter 1 |
| Tuesday  7/19 | * Cells in the nervous system | * AM – Lecture, Ted Talk Rebecca Saxe: How we read each other’s minds * PM – dissection and study of the sheep brain | The Tell Tal Brain-Chapter 2 |
| Wednesday 7/20 | * The cytology of neurons | * AM – Lecture, Discovering Nerve Tissue Lab, * PM – dissection and study of the sheep brain | The Tell Tal Brain-Chapter 3 |
| Thursday  7/21 | * Ion channels * Membrane potential | * AM – Lecture, Discussion of the Tell Tale Brain chapters 1-3 * PM – Modeling a Neuron & Action Potential | Study Guide for test |
| Friday  7/22 | * Overview of Synaptic Transmission * The Neuromuscular Junction | * AM – Lecture, Mammal Motor nerve Endings and Reflexes & Reaction Lab * PM – Test | Read and annotate journal article |
| Monday  7/25 | * Diseases that Affect Movement * Spinal cord and Spinal cord injury * Chemotherapy and peripheral neuropathy | * AM – Round table discussion of Journal Article, Lecture; Dissection of spinal cord * PM – *Movie Theory of Everything* | The Tell Tale Brain-Chapter 4 |
| Tuesday  7/26 | * Genes & Behavior Part 1 | * AM –TED Talk Sebastian Seung: I am my Connectome   Lecture   * PM – Pre-Lab C. elegans as a model organism | The Tell Tale Brain-Chapter 5 |
| Wednesday  7/27 | * Genes & Behavior Part 2 | * AM – Lecture and * PM: Lab C. elegans Behavior | C. Elegans Lab Report due Monday 8/1  The Tell Tale Brain-Chapter 6 |
| Thursday  7/28 | * The Brain & Perception | * AM – Lecture, TED Talk Oliver Sacks: What hallucination Reveals About our Minds * PM – Confusing the Senses Lab | Study Guide |
| Friday  7/29 | The disorder of thought and volition (Schizophrenia) | * AM – Lecture, Review, Test * PM –Video *A Beautiful Mind;* Introduction to Disease Project | Disease Project |
| Monday  8/1 | Disorder of Mood | * AM-Lecture; computer lab for disease project research * Video: *Brain series: Depression* | The Tell Tale Brain-Chapter 7 |
| Tuesday  8/2 | Emotional States & Feelings | * AM – Lecture; TED Talk Daniel Reisel: The neuroscience of restorative justice * LAB: emotion activity * PM - computer lab for disease project research | The Tell Tale Brain-Chapter 8 |
| Wednesday  8/3 | Motivational and Addictive states | * AM: Lecture; TED Talk Jill Bolte Taylor: My Stroke of Insight * Round table, creating strategies for health life style and high performance. * PM - Video: *TBD* computer lab for disease project research | The Tell Tale Brain-Chapter 9 |
| Thursday  8/4 | Topic TBD based on student interest | * AM – Discussion Tell Tale Brain; TED Talk Ed Boyden: A light Switch for Neurons * Lecture * PM – Student Presentations: Disease Project | Study Guide |
| Friday  8/5 | Catch up/Final evaluation | * Final Exam * PM - Parent conferences | * DUE: Research paper * **FINAL EXAM** |

**Instructor Biography**

Jennifer McQuade has a BS in Biotechnology and an MS in Biology from Purdue University. She earned her teaching certificate from Trinity Christian College and has been teaching honors and AP Biology at the high school level for the last 8 years. She has won the Outstanding Educator Award from the University of Chicago, and the Outstanding Science Teacher Award from the University of Minnesota. She also has nearly five years of independent research experience, most recently working at the University of Chicago studying pharmacogenomics and peripheral neuropathy. She has two publications, one in the Public Library of Science: Genetics, and the other in the Journal of Chemical Education. Additionally she is a candidate for National Board Certification in Adolescent and Young Adult Science education.

**Contact Information**

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**CTD Statement on Third-Party Web Sites**

Instructors are required to thoroughly review any third-party web sites they intend to use in their courses for inappropriate content. However, because web content continuously changes, CTD disclaims any responsibility for any of the content contained on third-party web sites used in course materials. If you become aware of anything that may be inappropriate, please notify CTD staff immediately.