MCS New Course Proposal Form

Course Title: Biochemistry of the Brain

Instructors: Daniel Brasier

Course Number: 03-366    Cross Listing: Click here to enter text.

Prerequisites/Corequisites: Prerequisite: 03-231 or 03-232

Semesters Offered:
- ☑ Fall
- ☐ Spring
- ☐ Summer-All
- ☐ Summer 1
- ☐ Summer 2

Semester Length:
- ☐ Mini 1
- ☐ Mini 2
- ☐ Mini 3
- ☐ Mini 4
- ☑ Full Semester

Location
- ☑ Pittsburgh
- ☐ Doha

Course Offering Frequency: Every Fall

Suggested Days and Times: MWF 11:30-12:20

Learning Format
- ☑ In Person
- ☐ Online
- ☐ Combination

Course Evaluation type:
- ☑ Letter Grade
- ☐ Pass/Fail

Course Unit Justification:
- Total Units 9

In Class Hours: 3 hours per week    Recitation Hours: 0

Lab Hours: 0    Out of Class Hours: 6 hours per week

Target Population: Advanced undergraduates majoring in biology, chemistry, or neuroscience. Also, students (especially premedical students) wishing to gain more experience with applied biochemistry.

Anticipated Enrollment: 40

Rationale for Course (Background): With the recent growth in neuroscience majors (approximately 20/year across Dietrich and MCS), the majority (approximately
12/year) of which are choosing the neurobiology concentration, there is a rising
demand for neurobiology electives. In surveying the 9 benchmark programs used as
a model for the creation of our Neuroscience major in 2014 (Brown, UPitt, Pomona,
Harvard, MIT, Brandeis, Rochester, NYU, Emory), 7 (all except NYU and Emory) have
dedicated courses in neuropharmacology or brain biochemistry; a topic for which
CMU does not have a course, the most common course offered at these benchmark
institutions that we currently lack. Furthermore, the neuroscience faculty in
Biological Sciences unanimously agree that this course is the most glaring absence
in our offerings. With that in mind, Aaron Mitchell and DJB conceived this course
designed around biochemistry of the brain. This course will play into the strengths
in the Department of Biological Sciences strength in biochemistry. Additionally, it
will provide neuroscience majors and other students (see target audience) an
opportunity to apply their knowledge of biochemistry to situations in the nervous
system – reinforcing that material.

Note on impact on other courses: the addiction material that will be taught both
qualitatively and quantitatively in this class overlaps partially with the strictly
qualitative discussion of addiction that used to be taught in 03-260 (Neurobiology of
Disease). In anticipation of this, 03-260 has been modified to remove the unit on
addiction and replace it with a unit that looks at diseases of neuronal
communication (myasthenia gravis, Lambert-Eaton syndrome, multiple sclerosis,
and Guillain-Barre syndrome).

**Special Facilities Needed**: None

**Assessment:** 3 in-class exams, weekly homeworks (except on examination weeks), group presentation, written report, final examination.

**Topics Covered:** 1) Basics of pharmacology (binding kinetics, types of inhibition -). 2) Neuronal communication and signal transduction. 3) Amino acid neurotransmitters. 4) Monoamines and related neurotransmitters. 5) Neuropeptides. 6) Other neurotransmitters. 7) Pain. 8) Neuroinflammation. 9) Biochemistry of sleep. 10) Addictive behaviors and tolerance/withdrawal. 11) Neuroendocrinology. 12) Biochemistry of injury and neurodegeneration.

**Course Catalog Description:** This course is designed to give students a comprehensive understanding of the major neurotransmitter systems in the brain. Students will explore qualitative and quantitative approaches to understanding how various neurotransmitters function as well as how they are modulated by endogenous and exogenous agents. The qualitative exploration will include basic principles of neural communication, signal transduction and second messenger systems, main classes of neurotransmitters, and the effects of medications and drugs of abuse. Quantitatively, we will explore the kinetics of neurotransmitter binding, affinity of different receptors for their neurotransmitters, and apply concepts of competitive, uncompetitive, and mixed inhibition to understanding the effects of exogenous agonists and antagonists on these receptors. Students will learn how these qualitative and quantitative biochemical processes affect the
Learning Objectives: Students who successfully complete this course will be able to:

1) Describe how neurotransmitters excite and/or inhibit postsynaptic neurons. 2) Distinguish the major chemical classes of neurotransmitters and their diverse functions, including: amino acids, monoamines, other small molecules, and neuropeptides. 3) Quantitatively describe the binding affinity for various different neurotransmitter receptors and explain how the different affinity can alter the behavior of these receptors when neurotransmitters are at different concentrations. 4) Explain the chemical basis of major topics in neuroscience, such as sleep, neuroendocrinology, and addiction. 4) Quantitatively describe the effects of exogenous medications and other drugs that act on neurotransmitter receptors. 5) Describe the distinction between agonists, allosteric modulators, inverse agonists, competitive antagonists, uncompetitive antagonists, and mixed antagonists both qualitatively and quantitatively and relate these concepts to enzyme kinetics and modulation.

Departmental Approval Date: Curriculum committee: January 27, 2016

Full department: _____

CUA Recommendation Date: Click here to enter text.

College Council Approval Date: Click here to enter text.

Date Sent to Enrollment Services: Click here to enter text.

Comments: Click here to enter text.

* Please attach a copy of the proposed syllabus