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An Undergraduate Neuroscience Seminar Based on the Annual Meeting of the Society for Neuroscience

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We have recently planned and taught an advanced undergraduate seminar at our respective institutions that uses a unique mechanism to explore topics that are on the cutting edge of neuroscience. The course material is centered on the topics of presentations scheduled for the Annual Meeting of the Society for Neuroscience held each fall. The instructor and students (~15) select several topics that are the subject of special lectures, panels, and keynote addresses included in the Program for the Annual Meeting. Each week the class reads and discusses several articles on the topic of one of the lectures, panels or addresses. By the time the Annual Meeting is held, the class is intimately familiar with the content of the planned presentations. The class then travels to the Annual Meeting and attends these presentations along with events of personal interest and keeps a journal of what they learn. Upon returning from the Annual Meeting, the students discuss the assigned presentations and also prepare and deliver their own presentation on a neuroscience topic of personal interest using information obtained at the

meeting. Students also prepare an in-depth final paper on their presentation topic in the form of a *Current Opinions in Neurobiology* review article. The outcomes for the students are many fold: Students explore topics on the cutting edge of neuroscience through the review of primary literature and experience a major scientific conference first hand, which is attended by over 30,000 neuroscientists from around the world. This experience helps neuroscience “come alive” for the students and provides them with valuable opportunities to meet world-renowned researchers, prospective graduate mentors, and possibly future employers. Students also have the chance to develop important professional skills through critical evaluation of research, exposure to different presentation styles, and preparation of an in-depth research paper and oral presentation.

Key words: Society for Neuroscience, seminar, annual meeting, scientific skills, current research

The field of neuroscience is not only incredibly broad and multi-disciplinary in nature, but it is also rapidly evolving. Indeed, the fast pace of neuroscience research and daily addition of new findings often results in neuroscience textbooks that become outdated soon after (or sometimes even before) publication. Even longstanding “facts” in neuroscience are not immune to the onslaught of new data. For example, it was only a few short years ago that practically every textbook and instructor heartily maintained that the birth of new neurons in the adult mammal simply did not occur. Now there are numerous reports and widespread acceptance of adult neurogenesis in the hippocampus (Christie and Cameron, 2006) and olfactory bulb (Lemasson et al., 2005; Hack et al., 2005), and possibly even the neocortex (Gould et al., 1999). Likewise, the existence of mRNA or transcription machinery in a dendrite was downright heresy, but now there is clear evidence of both (reviewed by Schuman et al., 2006). Keeping pace with these changes can make teaching neuroscience to undergraduates as challenging as it is exciting. However, we have recently used this to our advantage in developing and implementing a unique undergraduate course that capitalizes on the fast pace of neuroscience research.

The course is intended for upper level undergraduates majoring in neuroscience or psychology (with a biological concentration) and is taught as a seminar. The goal is to explore topics and issues that are on the cutting edge in

the field of neuroscience. To accomplish this, the specific topics selected for discussion during the semester are identified from the published list of symposia, panels, and lectures scheduled for the Annual Meeting of the Society for Neuroscience each fall. During the course of the term, students read background material and discuss the selected topics. Students then accompany the instructor to the Annual Meeting. This meeting is held every fall over the course of five days and is a gathering of over 30,000 scientists from around the world, who are conducting cutting-edge neuroscience research. Students attend symposium and data presentations on the topics discussed in the course and those of personal interest selected from the meeting program and published abstracts. Upon returning from the meeting, the class presents and discusses the research presented at the meeting. Students also have the chance to develop important professional skills through critical evaluation of research, exposure to different presentation styles, and preparation of an in-depth research paper and oral presentation.

COURSE PREPARATION

Admission of students. Since the course is aimed at advanced undergraduates with serious interest in neuroscience, we carefully interview interested students before accepting them into the course. This ensures that the enrolled students will have sufficient background in neuroscience principles and research so that students can

fully participate in and maximally benefit from class discussions and assigned readings. We also give preference to students who have conducted independent research projects in neuroscience or who have experience working in a neuroscience research laboratory. That experience has proven to be useful in facilitating critical discussion of original research papers. Lastly, we have found that limiting enrollment to 12-15 students per semester has fostered ample discussion as well as breadth of experience and personal interests.

Selecting topics for discussion. Prior to the start of the term, the instructor compiles a list of potential topics by looking at the titles of the special lectures, panels, symposia, and keynote addresses in the Program for the upcoming Annual Meeting of the Society for Neuroscience. One week before the first day of class, the instructor distributes the list of topics to the students so they may have a chance to look it over and identify topics of interest. On the first day of class, the instructor and students select several topics out of the list. The instructor tries to let student interest be the primary determinant of selection, as long as there is substantial breadth in the topics they choose, as well as sufficient representation of both basic and applied research. An example of the topics selected for a recent offering of the course is presented in Figure 1.

Selecting discussion leaders and readings. Once the list of final topics has been generated, the instructor has students take turns signing up to be the discussion leaders for each class meeting. During a 10-week term or 15-week semester, there is time to discuss between 10 and 14 topics before the Annual Meeting (depending on the exact dates of the meeting). This is based on a twice per week class meeting (100 minutes per meeting) for a 10-week term at Dartmouth College, or once a week meeting (180 minutes) for a 15-week semester at the University of Vermont. Usually 2 students sign up to be the leaders for each topic. Students are encouraged to sign up for topics of interest, but to also try to expand their horizons by selecting topics that may not be very familiar to them.

Students are encouraged to identify and recommend articles of interest throughout the term. Based on these suggestions, as well as our own literature searches, a list of readings is assigned for each class meeting and topic. Typically the readings include a review article and two original articles, with at least one by the person who will be presenting data on the topic at the Annual Meeting event. When possible, papers are selected that present opposing viewpoints on a topic, or alternate interpretations of data. For example, for a discussion on the neurobiological mechanisms underlying long-term potentiation (LTP), articles were selected that emphasized either presynaptic or postsynaptic mechanisms as being primarily responsible for underlying LTP.

COURSE FORMAT

Class meetings. The students in charge of leading the discussion for each topic are encouraged to come to class prepared with a list of questions and discussion issues, and to have looked up and read any pertinent additional papers. During the class meeting the discussion leaders

then pose the questions to the rest of the students. Depending on the particular papers that are assigned, the discussion leaders will also walk through the original research articles in a journal-club format. We have had the most success when the instructors resist taking over the discussion and instead remain more on the sidelines and participating from time to time just like other students in the class. At times, the instructors will also redirect the discussion or point out contradictory evidence, as well as mention tangential topics or implications.

In our experience, this format is sufficient to foster substantial discussion. On occasion, the discussion leaders have met with the instructors beforehand to address any confusing issues or to seek guidance on particular discussion topics. We have also implemented an ice-breaker during the first class meeting to get students used to speaking in class and talking about research by having each person describe his/her background, their particular interests in neuroscience and any relevant laboratory experience.

Advanced Neuroscience Seminar and Annual Meeting: Topics on the cutting edge in neuroscience	
Course Schedule	
Week 1	Sept. 22: Course introduction and planning
Week 2	Sept 27: Synapse development, plasticity, and receptor trafficking Sept 29: Object processing pathways
Week 3	Oct 4: Neuroplasticity and abused drugs including opioid systems Oct 6: Ethics of Cognitive Enhancement
Week 4	Oct 11: Messengers of life and death Oct 13: Neurobiology of schizophrenia, focus on cortical deficits
Week 5	Oct 18: The aging brain Oct 20: Stem cells and brain tumors
Week 6	Oct 25: Glial involvement in synaptic transmission and epilepsy Oct 27: Neurobiology of ADHD
Week 7	Nov 1: Sensory discrimination: codes, perception, memory, decision making Nov 3: Developmental changes in emotional and cognitive function
Week 8	Nov 8: Genes and sleep Nov 10: Motor system and motor dysfunction
Week 9	Society for Neuroscience Meeting (Nov 12-16)
Week 10	Nov 22: Meeting debriefing, workshop on professional skills Nov 24: No class – Thanksgiving Break
Week 11	Nov 29: In class presentations Dec 1: In class presentations
Final exam day - Dec 4: final paper due	
Grading	
Class participation: 35%; Annual Meeting Journal: 15%; Final Paper: 30%, Presentation: 20%	

Figure 1. Sample syllabus of topics from a recent course offering.

Annual Meeting preparation. By the time the Annual Meeting is held, the class is intimately familiar with the topics of many of the planned presentations. Scheduling conflicts naturally preclude students from attending all of the lectures and symposia that are related to the topics discussed in class. Thus prior to departing for the meeting, the students sign up for and agree to attend a minimum number of presentations (typically three), while be

encouraged to attend as many as possible. The students are also instructed on how to search for and find presentations and events of personal interest using the abstract search program available for the meeting.

In addition, we have asked students from our graduate programs who will be attending the meeting to volunteer to meet with two or three students from our class and orient them to the meeting. We have also done this ourselves by breaking the class down into small groups and meeting with a few students at a time. A meeting place and time is arranged with each group of students before leaving for the meeting.

Attending the Annual Meeting. On the first day of the meeting, students meet with either graduate student volunteers or the instructors and briefly tour the meeting site. The group also visits one to two posters that are of interest to the graduate student or instructor and observe how attendees interact at poster presentations. Otherwise, we have typically allowed the students to have free reign while at the meeting, and only instruct them to keep a detailed journal while attending talks and visiting poster presentations. On some occasions we have planned a class dinner mid-way through the meeting and also use the occasion to check in with the students.

The final weeks of class. Upon returning from the meeting, the first one or two class meetings are spent discussing the assigned presentations. The students who signed up for particular lectures or symposia generally lead the discussion and inform the rest of the group on the content of the presentation. It is often interesting to discover how the actual presentations did or did not differ from the related articles that were read in class.

During the final class sessions, each student presents a 15-minute talk on a neuroscience topic of personal interest using information obtained at the meeting. The presentations have varied in format from PowerPoint slide presentations to 'chalk-talks.' During these final weeks of class the students also prepare an in-depth final paper on their presentation topic, written in the form of a *Current Opinions in Neurobiology* review article. In writing the paper, students are instructed to draw primarily from poster and oral presentations they attended at the Annual Meeting. Of course some additional background information can be used from literature searches and library work. However, at least ten Annual Meeting presentations must be cited as references.

Grading. The final grade in the course is based on class participation (35%), quality of the journal kept during the Annual Meeting (15%), the final paper (30%) and the oral presentation (20%).

OUTCOMES

The outcomes for the students are many fold: Students have the opportunity to experience a major scientific conference firsthand, which is attended by over 30,000 neuroscientists from around the world. This experience helps neuroscience "come alive" for the students and provides them with valuable opportunities to meet world-renowned researchers, prospective graduate mentors, and possibly future employers. Indeed, several students have

made contacts that have led to jobs at NIH after graduation and admission to neuroscience graduate programs.

Students also have the chance to develop important professional skills through critical evaluation of research, exposure to different presentation styles, and preparation of an in-depth research paper and oral presentation. Several papers have been submitted and accepted by undergraduate research journals sponsored by our respective institutions. Overall, in our experience this course has been very well received by both students and fellow faculty members.

Feedback from previous participants. The rather novel format and content of the course has made it particularly important to review student course evaluations. Students have provided us with valuable information regarding the impact of the course as well as the format we have adopted and we have made several adjustments based on their comments. For the reader's information, we include several of them here:

"The format of the course was such a nice change from the typical lecture style course...and we learned about up-to-date research that is not yet available in textbooks."

"Attending the conference was a fantastic experience, but more could probably be required of us while attending the meeting."

"The trip to the conference was unreal. Class readings and discussion prepared me well for the intellectual level of the meeting, and I learned so much from attending."

"Fantastic class. I got a lot out of attending the conference. One suggestion might be that the instructor spends the first class session or two reviewing key background and methodology before we start reading specific articles."

POTENTIAL PITFALLS AND ALTERNATIVE FORMATS

It is possible that implementing this course, and attending the Annual Meeting in particular, could be challenging for students because of scheduling conflicts as well as financial concerns. Indeed, we have experienced situations in which a few students were unable to attend the entire meeting because of extracurricular commitments or unavoidable conflicts with other courses. In that case we ask that students at least attend the meeting on Saturday and Sunday (meeting usually runs from Saturday through Wednesday). In addition, we have found that it often helps if we communicate directly with the instructors of the students' other courses and explain the benefits of attending the meeting for as long as possible.

To our knowledge, we have not yet encountered a situation in which a student has been unable to enroll in the course and attend the meeting because of financial concerns. For several offerings of the course, we have been able to defray the cost of students' travel and meeting registration by soliciting funds from various departments and administrative bodies on our campuses. On other occasions we have not been able to secure funding; yet

course enrollment still reached our target number of students. Nevertheless, we encourage faculty who are considering teaching this course to actively seek out sources of funding from their institutions. In addition, we strongly recommend that the students room together and travel together to the meeting to reduce costs.

In the worst case scenario in which scheduling or financial issues preclude students from attending the meeting, it seems likely that the course could still be implemented. Indeed, selecting discussion topics from the Annual Meeting program provides a valuable means for students to learn about current hot topics in neuroscience. However, we feel strongly that students gain tremendously from actually attending the Annual Meeting. As mentioned previously, attending the meeting allows students to interact one-on-one with neuroscience researchers and much is to be gained by experiencing the excitement and energy at a large scientific conference.

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