Physiology and Neuroscience (NSC) Baccalaureate Degree

REPORT PREPARED by: Sonner, Patrick M.

ACADEMIC YEAR COVERED BY THIS REPORT: 2021-2022

I. PROGRAM LEARNING OUTCOMES

Graduates will be able to • 1) Predict physiological outcomes of alterations to neuronal membrane properties and ion concentrations. • 2) Predict how neurons will respond to various stimuli at the synaptic level. • 3) Demonstrate quantitative literacy by correctly using equations, accurately making calculations, and interpreting information provided in graphical form. • 4) Demonstrate the ability to solve novel problems. • 5) Demonstrate the ability to implement the scientific process – make observations, formulate a testable hypothesis, analyze the scientific literature to provide background information, develop a rationale, design an experiment, report results, and make conclusions. • 6) Demonstrate the ability to communicate effectively (oral & written). *Note: The Neuroscience, BS program changed the title of the program to Physiology and Neuroscience, BS in Fall 2022. While the program listed in the app is Physiology and Neuroscience, the program was titled Neuroscience in the 2021-2022 academic year. As such, the assessment will be written for the Neuroscience program that existed during the 2021-2022 academic year.

II. PROCEDURES USED FOR ASSESSMENT

A. Direct Assessment

Direct Assessment *For questions on the NEU 3100 midterm and final exams, most of the questions used to assess the program learning objectives are application style questions that are admittedly challenging and require a solid understanding of the concepts taught in class in order to then apply them to new situations. LO 1) Data were collected during both the midterm and final exams in NEU 3100 (How the Nervous System Works I) and compared between the two exams. Data were collected from all students in the course, and thus, are representative of all students who took the course. LO 2) Data were collected during the final exam in NEU 3100 (How the Nervous System Works I). Data were collected from all students in the course. LO 3) Data were collected from

specific questions on the midterm and final exams in NEU 3100 (How the Nervous System Works I). Data were collected from all students in the course, and thus, are representative of all students who took the course. LO 4) Data were collected from specific questions on the final exam in NEU 3100 (How the Nervous System Works I). Data were collected from all students in the course, and thus, are representative of all students who took the course. LO 5) Data were collected from a written document in NEU 3200 (How the Nervous System Works II). This assignment was designed to have students develop a logical follow-up experiment to one that we discussed extensively in class. Data were collected from all students in the course, and thus, are representative of all students who took the course. As well, data were collected from a written document in NEU 2010 (Introduction of Neuroscience Research). This assignment was designed to have students work in a group on designing a follow-up experiment from a research article read for the class. LO 6) Data were collected from oral presentations during a group project in NEU 1020 (The Neuroscience of Learning), an oral presentation on the experimental design proposal in NEU 2010 (Introduction of Neuroscience Research), and written and oral projects in NEU 3200 (How the Nervous System Works II). Data were collected from all students in these courses, and thus, are representative of all students who took the courses.

B. Scoring of Student Work

Scoring of Work LO 1) There are scoring rubrics used for all questions on the midterm and final exams in which students can earn varying amounts of points depending upon elements of the questions which are correct or not. Dr. Patrick Sonner (course instructor) did the scoring. LO 2) There is a scoring rubric used for this question on the final exam in which students can earn varying amounts of points depending upon elements of the questions which are correct or not. Dr. Patrick Sonner (course instructor) did the scoring. LO 3) There are scoring rubrics used for all questions on the midterm and final exams in which students can earn varying amounts of points depending upon elements of the questions which are correct or not. As well, there are some points given out for students showing their work and incorporating appropriate units. Dr. Patrick Sonner (course instructor) did the scoring. LO 4) There are scoring rubrics used for all questions on the midterm and final exams in which students can earn varying amounts of points depending upon elements of the questions which are correct or not. Dr. Patrick Sonner (course instructor) did the scoring. LO 5) There was a scoring rubric used to assess students' written documents and their ability to implement the scientific process. Dr. Patrick Sonner (course instructor) scored the entire NEU 3200 class. Dr. Kathy Engisch used a rubric to assess students' writing on experiment design and implementing the scientific process. Dr. Engisch scored all students in NEU 2010. LO 6) There were scoring rubrics used to assess student's ability to communicate effectively, in NEU 1020, NEU 2010, and 3200. In NEU 1020 and 2010, Dr. Kathy Engisch (course instructor) provided the scoring, while in NEU 3200, Dr. Patrick Sonner (course instructor) scored all oral presentations.

C. Indirect Assessment

Indirect Assessment There are two primary indirect assessments currently in use by our program. The first is the set of end of course assessments provided by Wright State University, across all courses in the program. The second is the Student Assessment of Learning Gains (SALG) survey given to all students at the end of NEU 3100 and NEU 3200. The SALG assessment is much more specific to the learning outcomes for both NEU 3100 and NEU 3200. Finally, going forward, we would like to incorporate an end of program assessment for the program learning outcomes. This could be given to students in both final senior capstone courses, NEU 4020 and NEU 4040. Thus, since all students must complete one of the capstones to finish their degree requirements, we would be able to have all students take the end of program assessment survey. We implemented this survey for the first time in Spring 2022.

III. ASSESSMENT RESULTS/INFORMATION:

LO 1 – based upon 2 midterm exam questions and 2 final exam questions LO 2 – based upon 1 question on the final exam LO 3 – based upon 2 questions on the midterm and 3 questions on the final exam LO 4 – based upon 3 questions on the final exam LO 5 – For NEU 3200, it is based upon a written document analyzing a research article, and also based upon group presentations of this analysis. For NEU 2010, it is based upon a written document in which students design an experiment as a follow-up to already existing primary research literature. LO 6 – For NEU 1020 it is based upon a group oral presentation. For NEU 2010, it is based upon a group oral presentation. For NEU 3200 it is based upon an individually written document and an oral group presentation. SALG – Indirect Assessment survey at the end of NEU 3100 and NEU 3200

LO 1 Fall 2020 Midterm Q5=87.28%; Q16=84.64% Fall 2021 Midterm Q5=81.875%; Q16=69% Fall 2020 Final Q1=68.11%; Q4=79.53% Fall 2021 Final Q1=60.83%; Q4=80.5% The average of the 2 midterm questions declined from Fall 2020 to Fall 2021 (5.40% decrease and 15.64% decrease, respectively). Question 5: Overall, students did relatively well on Question 5. However, it was disappointing to see a 5% decrease in the average score. The few who struggled seemed to mix up which way the ion would flow under the different conditions. And, while we spend a lot of time going over this and teach them the easiest way to apply this, some students opt to try and memorize the chart for the sign of the driving force and which direction ions will flow across the membrane. Every year, at least one student attempts this and ends up making unnecessary errors in their thought process. I'm not sure how to best remedy this, but perhaps additional out-of-class problems related to this would be fruitful. Question 16: It was very disappointing to see such a dramatic drop on the average score for Question 16. This is something that we go over heavily in the first half of the course,

and it is applied again for Ca2+ in the second half of the course, but we could try reviewing the Na+ I/V plot more specifically during the final exam review. The average of the 2 final questions were split, with one decreasing and the other increasing Fall 2020 to Fall 2021 (7.28% decline for Question 1, and 0.97% increase for Question 4). Question 1: The primary issues with Question 1 appear to be the inability to correlate a calculated equilibrium potential with a graphically displayed equilibrium potential on an I/V plot. As well, students struggled with determining what kind of channel it would be from the shape of the plot. Going forward, more time should be devoted to differentiating linear from non-linear I/V plots and the respective channels that underlie them. This could most effectively be done once past the leak channels and discussing the voltage-gated channels. Question 4: Question 4 was largely unchanged year over year, and the averages were relatively strong. However, a noticeable issue for some students is the inability to calculate current. They tended to get confused on driving force and just multiplied the conductance by the equilibrium potential. I think this could be remedied by offering more extensive final exam review going forward. LO 2 Fall 2020 Final Q11=58.10% Fall 2021 Final Q11=68.75% There was a 10.65% increase year over year for Question 11 on the final exam. Question 11: While we were delighted to see an improvement on the question, the average score is still lower than we would hope. Going forward, more time will be devoted in-class to discussing the histograms, how to interpret them, and how to conduct the necessary calculations from them. As well, we will assign a similar style homework problem to be completed outside of class that students will then get feedback on. LO 3 Fall 2020 Midterm Q5=87.28%; Q16=84.64% Fall 2021 Midterm Q5=81.875%; Q16=69% Fall 2020 Final Q1=68.11%; Q4=79.53%; Q11=58.10% Fall 2021 Final Q1=60.83%; Q4=80.5%; Q11=68.75% LO 3 - As these are based upon the same questions mentioned above for LO 1 and LO 2, the summary results, underlying issues, and approaches for improvement in the future are the same. LO 4 Fall 2020 Final Q1=68.11%; Q4=79.53%; Q11=58.10% Fall 2021 Final Q1=60.83%; Q4=80.5%; Q11=68.75% These have already been discussed in LO 1 and LO 2. However, to summarize, there was a year over year decrease in Question 1 (7.28%) and an increase in the other two questions (0.97% for Question 4 and 10.65% for Question 11, respectively). The underlying issues and approaches for improvement have been mentioned in LO 1 and LO 2. LO 5 Spring 2022 NEU 3200 Average CREATE Project Points were 14.3875/18 (79.93%). This is slightly down from Spring 2021 in which the average of the CREATE Project document was 15.73/18 (87.41%). While there is not a large point difference year over year (~1.4 points lower in spring 2022), there was a nearly 8% point difference due to the low number of points in total. While there were several students who did not submit a revised document based upon feedback, those that did tended to have issues with detail in their experimental design and explaining how the results support their hypothesis. I feel like a lot of this could be addressed by requiring students to submit a final draft with revisions. As it stands currently, they don't have to revise if they are happy with their initial draft score. NEU 2010 Fall 2021 Average scores for Fall 2021 were: (Scores are for group project but individuals were responsible) Hypothesis, 2.97 ± 0.06 Background, 2.42 ± 0.63 Gap & Importance (= Rationale), 2.91 ± 0.1 Experimental Design, 2.85 ± 0.12 Results, 2.88 ± 0.12 Conclusion, 3 The consistent issues were: 1) On Background, 1 student did not do the assignments relevant to understanding what is expected for background, bringing that score down 2) On Experimental design, 2/3 groups were missing key experimental details in their

design/flow diagram slides 3) There was significant improvement in the Rationale when it was separated into the Gap in knowledge and the big picture importance over previous years when it was called "Rationale". 4) On Results, issues included that the groups to be compared were not on the same graph/slide; lacking error bars; time course not using appropriate style (line + symbol) These areas are all taught one by one throughout the class, but the students are creating their final project slides in the last couple of weeks and are not remembering/applying what they previously learned. Could be addressed by providing a summary sheet with the key points for each section, like a blue print (in theory this is in the rubric but again, they are not delving into the rubric when they are in the throes of creating their slides.) Alternatively (or in addition), assign the drafting of slides to occur right after the lesson is taught. For example, the group members doing the background, would submit their draft slides right after that section is completed in class. Likewise, the group members doing the experimental design would submit right after the experimental design lesson. And everyone in the group should be helping with those slides. Average scores for Fall 2021 were: (Scores are for group project but individuals were responsible) Hypothesis, 2.97 ± 0.06 Background, 2.42 ± 0.63 Gap & Importance (= Rationale), 2.91 ± 0.1 Experimental Design, 2.85 ± 0.12 Results, 2.88 ± 0.12 Conclusion, 3 The consistent issues were: 1) On Background, 1 student did not do the assignments relevant to understanding what is expected for background, bringing that score down 2) On Experimental design, 2/3 groups were missing key experimental details in their design/flow diagram slides 3) There was significant improvement in the Rationale when it was separated into the Gap in knowledge and the big picture importance over previous years when it was called "Rationale". 4) On Results, issues included that the groups to be compared were not on the same graph/slide; lacking error bars; time course not using appropriate style (line + symbol) These areas are all taught one by one throughout the class, but the students are creating their final project slides in the last couple of weeks and are not remembering/applying what they previously learned. Could be addressed by providing a summary sheet with the key points for each section, like a blueprint (in theory this is in the rubric but again, they are not delving into the rubric when they are in the throes of creating their slides.) Alternatively (or in addition), assign the drafting of slides to occur right after the lesson is taught. For example, the group members doing the background, would submit their draft slides right after that section is completed in class. Likewise, the group members doing the experimental design would submit right after the experimental design lesson. And everyone in the group should be helping with those slides. LO 6 Spring 2021 NEU 3200 Written=89.42%; Oral=95.34% Spring 2022 NEU 3200 Written=83.76%; Oral=95.5% The NEU 3200 results indicate that overall, the data for the written document decreased by 5.66% and the oral presentation grades improved by 0.16% from Spring 2021 to Spring 2022. As such, the grades on the oral portion of the assignment were quite strong, but the written portion could have been better. For the written document, students submit an initial draft and get extensive feedback. However, there were several students who either didn't make any revisions in order to improve their document or score, or some who only did minimal revisions. I'm not entirely sure how to improve this as the deadlines are given out 8 weeks in advance, and there is extensive feedback given for improvement to be made. Beyond that, the most common issue that I see across students' documents is a lack of detail when describing experimental results. I

could have them submit a single section of the document prior to their full initial draft in order to get feedback and try and focus on the level of detail supplied. This may be challenging, however, due to the tight schedule of the project. Spring 2022 NEU 1020 Average scores for Spring 2022 were: Slides, 2.83 ± 0.20 Oral, 2.77 ± 0.26 Content, 2.77 ± 0.32 The consistent issues were: 1) Slides lacking consistent design; missing an image for one or more slides; slides too busy and/or font too small I did not take off for this, but very few students had an image that provided information rather than just visual interest 2) Orally, students had either not practiced, or became super nervous. They struggled to find words; read directly from slides; inserted verbal tics such as "uhm" and "yup". 3) Content, students did not provide information from an outside source, or, presented confusing or incorrect information Most of the issues can be addressed if I am able to review the presentation before it is given to the class, and students in groups that did this came closer to full credit than those who did not. The issue of practicing could also be addressed if I have as part of their grade a practice session with me after there has been feedback on the slides. It is difficult to have time for this outside of class, and inside of class it is difficult to pay attention to one group, what are the other groups doing? But this could be addressed by developing an in-class activity students in the other groups could do without my input. Fall 2021 NEU 2010 Average scores for Fall 2021 were: Slides, 2.87 ± 0.22 Oral, 2.74 ± 0.24 The consistent issues were: 1) Slides with too small font, or not enough images 2) Oral, reading slide, struggling for words, speaking too quickly, too brief, or too much information that is not on slide I did not insist that they show me their slides ahead or practice in front of me, so there were more issues with oral presentation than in NEU 1020. Can be addressed by having the group share their slides prior to their presentation, and, making time in class for practice. On the whole, most students adhere to the rubric for the slides. SALG SALG - The overall results are reasonably positive as the average responses for understanding of concepts in NEU 3100 were relatively similar year over year. The average reported conceptual understanding for all topics declined from 4.6 (Fall 2020) to 4.208 (Fall 2021) with a 4 indicating students self-identifying with good gains to a 5 indicating students self-identifying with great gains across all topics in the course. The self-reported scores ranged from 4.2-4.8 in Fall 2020 and from 3.5-4.9 in Fall 2021. Interestingly, the lowest scored topic, Molecules of Synaptic Transmission, was brand new and only taught for the first time in Fall 2021. As well, this topic was taught the same day the SALG was taken, and only two days prior to the final exam. So, at the time, students may not have felt particularly solid on the information. Going forward, if the topic ends up being taught on the same day as the SALG and just before the final exam, it will be taught, but excluded from the final exam. With regards to the SALG for NEU 3200 in the spring of 2022, unfortunately, there was a technical issue which prohibited any students from accessing that assessment. As such, we do not have SALG information for NEU 3200 in spring 2022 to compare against spring 2021. Neuroscience Program Exit Survey We had 9 students complete the exit survey, which is a good start. However, we need to determine a way to ensure completion in either of the senior capstone courses. Regardless, the feedback was overall, very positive. 8/9 ranked the quality of education in the Neuroscience major as a 5/5. The other student ranked it a 4. A Likert-scale series of questions regarding program content and competencies was given. Unfortunately, this wasn't in the format of the Program Learning Outcomes. So,

while there isn't a direct correlation that can be made, the content and competencies do overlap with the program learning outcomes, and across all survey questions, they were all almost exclusively 4's or 5's (5 being the best). We will have to revise the exit survey going forward to directly match the program learning outcomes.

LO 1 - Fall 2018 Midterm Q6=88.35%; Q19=90.91% Fall 2019 Midterm Q6=76.44%; Q19=86.15% Fall 2018 Final Q1=78.79%; Q4=76.82% Fall 2019 Final Q1=75.64%; Q4=79.04% *All scores are the average percentage students received on the respective questions. LO 2 - Fall 2018 Final Q13=64.77% Fall 2019 Final Q13=62.26% *All scores are the average percentage students' received on the respective questions. LO 3 - Fall 2018 Midterm Q6=88.35%; Q19=90.91% Fall 2019 Midterm Q6=76.44%; Q19=86.15% Fall 2018 Final Q1=78.79%; Q4=76.82%; Q13=64.77% Fall 2019 Final Q1=75.64%; Q4=79.04%; Q13=62.26% *All scores are the average percentage students' received on the respective questions. LO 4 - Fall 2018 Final Q1=78.79%; Q4=76.82%; Q13=64.77% Fall 2019 Final Q1=75.64%; Q4=79.04%; Q13=62.26% *All scores are the average percentage students received on the respective questions. LO 5 - NEU 1000 Fall 2018 Hypothesis=98.5%; Rationale=88.7%; Flow Diagram=93%; Design Elements=86%; Results=90.7%; Discussion=94.5% NEU 1000 Fall 2019 Hypothesis=96.9%; Rationale=98.2%; Flow Diagram=95%; Design Elements=96.6%; Results=93.8%; Discussion=90.9% *All scores are the average percentage students received on the respective questions. LO 6 - NEU 1000 Fall 2018 Final Project Hypothesis=87.5%; Background=95.8%; Rationale=85.4%; Flow Diagram=96.5%; Design Elements=95.1%; Results=90.3%; Conclusions=84.7% NEU 1000 Fall 2019 Final Project Hypothesis=97.9%; Background=91.7%; Rationale=94.5%; Flow Diagram=94.0%; Design Elements=85.4%; Results=89.8%; Conclusions=87.3% NEU 1000 Fall 2018 Oral Presentations Slides=93.0%; Speaking=95.0% NEU 1000 Fall 2019 Oral Presentations Slides=91.9%; Speaking=93.7% NEU 3200 Spring 2019 Written 92.25%; Oral 97.27% NEU 3200 Spring 2020 Written 87.97%; Oral 92.90% *All scores are the average percentage students received on the respective assignments. SALG - The detailed statistics for each surveyed element can be seen in the attached SALG survey (Statistics tab), along with open-ended responses in the Data tab. However, an encouraging result was that the students self-identified that they made between good and great gains in their understanding of the main concepts explored in the class (mean=4.6; n=23). Also, students self-identified that they made good to great gains in their understanding of the relationships between the main concepts in the course (mean=4.2; n=23).

IV. ACTIONS TO IMPROVE STUDENT LEARNING

Information Sharing and Actions Information regarding the assessment has been shared between faculty in the department associated with the program. Discussions were had regarding approaches and strategies to try and improve learning outcomes. As a result, we began by changing our freshman and sophomore course sequence from NEU 1000 (freshman year) and NEU 2000 (sophomore year) to NEU 1010 and 1020 (freshman year) and NEU 2010 (sophomore year), in order to allow for more focused time in the coursework to aid in students developing and

improving their scientific communication skills, as well as implementing the scientific process more effectively. Also, students felt that there was too much work involved in an introductory freshman course. Thus, the research related aspects will be moved to the sophomore level course (which was assessed for the first time in the 2021-2022 academic program assessment). Since this newly structured freshman/sophomore sequence is so new, we don't have any insight yet as to whether benefits to the associated learning outcomes will be gained. We also made modifications in NEU 3100 to spend more time on some of the associated topics in class to address the content specific learning outcomes. Since these alone didn't provide sufficient improvements, we will implement alternative strategies including more out of class homework assignments to improve their abilities to apply concepts learned in class to new scenarios. Also, going forward, we will annually spend time during a departmental education committee meeting providing results of the assessments and discuss strategies for improvement. Additionally, we have an Advisory Board which is comprised of an interdisciplinary group of faculty at WSU. We would like to share the results of our assessment with them and get their feedback on ideas for improvement.

V. SUPPORTING DOCUMENTS

Additional documentation, when provided, is stored in the internal Academic Program Assessment of Student Learning SharePoint site.