Physiological Psychology

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This chapter provides class and laboratory activities related to the teaching of physiological psychology. Physiological psychology can be challenging for students due to the amount of unfamiliar material related to brain anatomy and physiology. One way to foster student learning in this area is to demonstrate terminology and concepts using engaged activities. This chapter summarizes several effective strategies that instructors can use.

The activities presented here are divided into three areas: nerve cell communication, brain structure and function, and behavioral pharmacology. A final section provides instructors with a creative game to prepare for a final exam in physiological psychology. Although the exercises most closely align with the material in a physiological psychology course, instructors should envision ways to apply them in introductory psychology, sensation and perception, developmental psychology, human neuropsychology, and psychopharmacology courses.

Sheep Brain Dissection in a Physiological Psychology Laboratory Course (Unpublished Class Activity)

Dissection of a preserved sheep brain can aid student learning of neuroanatomical structures and functions. In the laboratory section of physiological psychology, students investigate a sheep brain using a dissection guide from Carolina Biological Supply Company (Burlington, NC). The instructor guides them through the dissection by performing all the required steps. This is a critical component of the lab as students generally value observing the procedures first before being asked to work individually. Each student receives his or her own sheep brain and must complete the dissection steps in 1 hour. Students normally accomplish this task quite easily, and they generally have additional time to rehearse the listed brain regions and functions. It is important to monitor the dissection process and attend to individual questions. For these reasons, the lab is best suited for 10-15 students.

After the first dissection lab, students receive a second sheep brain the following week and perform the steps again. During the second lab dissection, students are quizzed on brain structure and function without notes or the dissection guide. They are asked to individually dissect the brain in 15 minutes without assistance. Next, students are randomly called into a separate lab room for a verbal quiz. A typical brain quiz involves identification of 26 sheep brain structures and corresponding functions. Informal assessment of this activity seems to indicate that many students enjoy the experience, as many have not dissected brain tissue before. Further, students indicate that indentifying sheep brain structures and functions helps them to transfer knowledge to the human brain.

Annotated Bibliography

Active Participation of Neuronal Communication

A. Hamilton and Knox (1985) described a large lecture demonstration (which be modified for smaller classes) of the anatomy and physiology of neurons. Thirty student volunteers act out the cellular processes involved in presynaptic and postsynaptic neuronal activity. Students are assigned to the following roles: muscle cell, afferent and efferent axons, soma, dendrites, synaptic knobs, receptors, neurotransmitters, enzymes, sodium ions, and action potential. The authors provided detailed steps for conducting this 30-min activity and described necessary props and materials. Student evaluation of the exercise indicated that this demonstration was more helpful than a lecture review in understanding neuronal communication.

- Hamilton, S. C., & Knox, T. A. (1985). The colossal neuron: Acting out physiological psychology. *Teaching of Psychology, 12*, 153-156.

Felsten (1998) described an active participation exercise in which students demonstrate action potentials in myelinated and unmyelinated axons. Students come to the front of the class and act as a segment of an axon. The position of the students' hands represent the membrane potential—hands below the head have a negative membrane potential whereas hands above the head are positive. By changing the position of the students' hands, the instructor can demonstrate resting and graded potentials, the all-or-none threshold, and the action potential. The same instructions can be applied to showing students how the speed of the action potential differs in myelinated and unmyelinated axons. Assessment of the exercise showed that introductory psychology students and upper-level students who participated in the activity had higher quiz scores than students who were dismissed from class after hearing a lecture over the same material. In addition, students rated the activity as more helpful, interesting, and fun than a textbook explanation of the generation and transmission of action potentials.

- Felsten, G. (1998). Propagation of action potentials: An active participation exercise. *Teaching of Psychology, 25*, 109-111.

Reardon, Durso, and Wilson (1994) described exercises to demonstrate neuronal function and communication. The first set of demonstrations focus on neural coding, showing how excitatory and inhibitory postsynaptic potentials summate to produce an action potential. Seven students can participate—one in a receiving neuron role and six as excitatory inputs. Students acting as neuronal inputs receive an index card marked with the letter "E." The student acting as the receiving neuron fires an action potential only when three "E" cards are flashed. The simulation can last for 1 or 2 min. The second exercise incorporates the effect of inhibitory signals on neuronal function, and instructions are given to demonstrate temporal and spatial neuronal summation. The second set of demonstrations uses the concept of "musical chairs" to teach students synaptic transmission including concepts of neurotransmitter release, blocking receptors sites, and preventing reuptake of neurotransmitters. The effectiveness of the neural coding exercise was assessed by comparing students in the exercise condition to students in a lecture condition on a quiz of neural coding. Students in the neural coding exercise condition achieved higher quiz percentages compared to the lecture groups. There was no assessment of the effectiveness of the synaptic transmission exercise.

- Reardon, R., Durso, F. T., & Wilson, D. A. (1994). Neural coding and synaptic transmission: Participation exercises for introductory psychology. *Teaching of Psychology, 21*, 96-99.

Demonstrations of Brain Function and Neuro-anatomy

Morris (1991) described five activities that illustrate the verbal and visual deficits seen in patients with a severed corpus callosum (i.e., split-brain patients). Two students sit next to each other in the same chair. The student on the left becomes the left hemisphere of the brain and the other student is the right hemisphere. Using only their crossed inner hands (outer hands are placed behind their backs), students are asked to perform a variety of functions with and without a blindfold, including tying a shoe and object recognition tasks. An important aspect of the exercise is that the student acting as the left hemisphere (where language is generally localized) is instructed to give no verbal cues to the right hemisphere, which approximates the behavioral difficulties observed in split-brain patients. The majority of students in introductory psychology courses rated the demonstration as either "helpful" or "very helpful."

- Morris, E. J. (1991). Classroom demonstration of behavioral effects of the split-brain operation. *Teaching of Psychology,* 18, 226-228.

Wilson and Marcus (1992) described a unique way to teach the neuroanatomy of a sheep brain by having students construct a brain using PlayDoh™. Students are instructed to use PlayDoh™ to model all major brain regions and structures. In the article, the authors provided instructions for the brain construction as well as hand-drawn figures of the PlayDoh™ brain from various neuroanatomical directions. The lab to create the brain model takes 1.5 hrs to complete. Overall, students rated the PlayDoh™ brain model lab as a positive learning experience (average of 6.1 on a 7-point scale). Further, the authors argued that the modeling lab can help students understand the brain's three-dimensional nature and can be used as an effective supplement to traditional sheep brain dissections.

- Wilson, C., & Marcus, D. K. (1992). Teaching anatomy of the sheep brain: A laboratory exercise with PlayDoh™. *Teaching of Psychology, 19,* 223-225.

Daniels (1979) also used a modeled brain activity to help students learn neuroanatomy of the human brain. Students were asked to construct a sagittal (half) section of the human brain using clay. The construction of all the major neural regions and structures were thoroughly described in the article. Informal and formal student feedback indicated that the activity was "interesting" and "useful." Further, the vast majority (90%) of students who made clay brains indicated that the task was "helpful" or "very helpful" in learning brain structures.

- Daniels, C. E. (1979). Should a psychology student have a brain of clay? *Teaching of Psychology, 6,* 175-177.

Demonstrations of Behavioral Pharmacology

Students in a physiological psychology course determined the effects of a variety of psychoactive drugs by observing the behavior of hooded female rats. The instructor assigns students into five teams (two students per team). Students are instructed to weigh and handle the rats for 2 weeks prior to drug testing. Students read articles relevant to animal drug studies, and each team identifies four to six behavioral tests that could be used for the lab. The instructor then selects five drugs to use (from a list of 20 possible drugs). The drugs selected belonged to one of the following categories: sedative-hypnotics, barbiturates, stimulants, or ethanol. The instructor gives drug injections to the rats 2 hrs prior to the student observations. Students are required to observe and record the behavior of rats in both a drug and nondrug state (control). Three progress reports are assigned to students in which they determine the general and specific drug category given to the rats, the drug name, and supportive literature findings. The author found that most teams were able to identify correctly the general drug category administered. Students reported that they were enthusiastic about the lab activity.

- Schumacher, S. J. (1982). An alternative to the traditional physiological laboratory: Identification of an unknown drug through behavioral testing. *Teaching of Psychology, 9,* 239-241.

Briner (1996) provided a behavioral pharmacology demonstration that would be well suited for a physiological psychology laboratory. Similar to Schumacher (1982), students are required to record the behavior of rats following the administration of certain classes of drugs. The drugs include lead, barbiturates, amphetamine, anticonvulsants, steroids, and antipsychotics. Through this demonstration, students observe dose-response characteristics of several drug classes and learn the importance of selecting the appropriate behavioral test(s) in pharmacological research.

- Briner, W. (1996). Animal demonstrations of human conditions for the physiological psychology laboratory. *Journal of Instructional Psychology, 23,* 183-188.

Final Exam Preparation for Physiological Psychology

Ackil (1986) described an activity in which students participate in a final exam review session for physiological psychology by playing a game called PhysioPursuit. The questions are asked in a trivia-style format similar to the popular board game, Trivial Pursuit. Throughout the semester, the instructor prepares a variety of short-answer questions on 3- x 5-inch index cards. These cards are used as the question cards during the game. The game is played on a gameboard with a picture of the brain in the center and individual game pieces representing different colored neurons. Ackil found that students enjoyed the competition of the game and seemed to learn new material.

- Ackil, J. E. (1986). PhysioPursuit: A trivia-type game for the classroom. *Teaching of Psychology, 13,* 91.