Assessment of Non-Academic Outcomes (Fall 2003 and Spring 2004)

Please provide the information below about how your unit assesses the extent to which it meets its expected outcomes. If you need assistance, please contact Dr. Virginia Wheeless at 565-2085 or on Groupwise email. This information is due in the Planning Office no later than February 2, 2004 and will be updated annually.

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Unit: _CENTER FOR NETWORK NEUROSCIENCE___________**Date** __Feb. 13, 2004____

Person Completing the Information __Prof. G.W. Gross____ **Email** gross@cnns.org

Head of the Unit: __ Prof. Gross_______________________ **Email** gross@cnns.org

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I. Mission: Provide the mission of the unit and a statement about how it relates to the university's mission.

Interdisciplinary research on nerve cell network dynamics and applications of such systems to pharmacology, toxicology, basic neuroscience research, advanced computer design, and tissue-based biosensors.
This represents a frontier research area in which this Center is internationally competitive.

II. Previous Evaluations of the Unit: Provide a description of the evaluations/assessments conducted in your unit over the last 5 years and changes that have been made based on the results of these assessments.

1998 Sunset Review. A positive review that did not make recommendations. In the sciences we respond to the dynamics of our discipline through national and international meetings, grant opportunities, and publications. Internal reviews have little impact on how we need to operate in the international scientific arena.

III. Statement of Expected Outcomes: Provide a brief list of the expected outcomes for your unit for 2002-03 or 2003-04 as of this date. Each outcome listed must be capable of being measured by the means noted in IV below. Please number the outcomes (1 to x). After each outcome, describe how the outcome supports student learning and student development.

We have received a Texas Advanced Technology Program grant (TDT, Jan 04 – Dec 05; $200,000 with another $200,000 in kind matching from local industry) and are obligated to complete the research offered in the Statement of Work. Progress reports have been defined by the Texas Coordinating Board. There are no other assessment methods except ingenuity, productivity, and publications. As long as we have graduate programs in science, we must have competitive, active labs for that training. The PhD is a Research Degree!

IV. Measuring Expected Outcomes: Describe how the unit measures how the outcomes have been achieved and provide a list of methods and/or tools with the following information:

1. Name of assessment method or tool
2. If the method/tool is copyrighted, provide the name of the company who "owns" the tool.
3. Frequency of use - how often is this tool/method used, e.g., every spring semester students, staff, and faculty are surveyed about parking at UNT; customers are asked to complete evaluation forms when services are rendered; or each fall, the Enrollment Management Committee reviews the results of the Graduating Student Survey produced by the IR&A Office.

ABSOLUTELY NOT APPLICABLE!!!

V. Use of Assessment Results: Describe how the results of the assessments described in IV above are shared with staff in the unit? How are the results used to improve the unit? Help improve student learning? Enhance student development? Meet the university's vision?

NOT APPLICABLE

VI. Changes Made Based on Assessment Results: Describe how the unit has changed (or why it has not changed) based on the results of the assessment of outcomes. Indicate the year the change was implemented. Please indicate how the expected outcomes have changed if applicable.

NOT APPLICABLE

Signature of Person Completing the Form:

____ Date _____________________

Signature of Unit Head after Reviewing the Form:

____ Date _____________________

UNIVERSITY of NORTH TEXAS
Center for Network Neuroscience Research Profile

CNNS

NEURONAL NETWORKS on MICROELECTRODE ARRAYS

Novel platforms for investigations of Information Processing & Storage, Pattern Generation, Network Self-Organization, Fault Tolerance, Trauma, and Central Nervous System Diseases.

Application Areas: (1) General and Environmental Toxicology, (2) Drug Development, and Pharmacology. (3) Broad-Band Biosensors for chemical warfare and homeland security. (4) Medical Neurobiology, Neurophysiology, and Computational Neuroscience, (5) Advanced Computer Engineering.

Introduction: The Center for Network Neuroscience (CNNS) at the University of North Texas has pioneered studies of nerve cell networks growing on microelectrode arrays in cell culture along with the associated development of multisite recording and data analysis techniques. Prof. Gross (Director, CNNS) was first to record signals from nerve cells using substrate-integrated microelectrodes. He has published over 100 articles, and has remained a leader in this now rapidly growing field. Electronic and computer support systems as well as software data analysis strategies have recently matured to a point where a major expansion of this field is imminent. *The emerging knowledge base will have a strong impact on our understanding of information processing in the brain and opens a wide range of lucrative applications in medicine, homeland security, environmental toxicology, drug development, and computer science.*

Neuronal Networks on Microelectrode Arrays are assemblies of mammalian nerve cells growing on non-invasive microelectrode arrays in culture. The cells remain viable for over 6 months and form spontaneously active networks. When exposed to neuroactive or toxic compounds, changes in signal patterns are detected by the microelectrodes, indicating alteration in the physiological state of the network. Because major mechanisms present in the brain are reflected in cell culture, such systems provide a reliable model for many physiological functions of brain tissue. Over 90 substances, including bacterial toxins, metabolic poisons, toxic metals, neuropharmacological compounds, and hallucinatory drugs, have generated histiotypic (i.e. like the parent tissue) responses in cultured networks.

Application Areas: The robustness of the system allows recordings of electrical activity for many weeks, storage for 2 weeks in a sealed environment, and worldwide shipping without a special life support. Sophisticated application efforts are now realistic: (1) *Neuronal Network Biosensors (NNBS):* Two consecutive contracts from DARPA and collaboration with the Naval Research Laboratory have established such networks to be broad-band biosensors. They allow not only sensitive detection, but also provide information on the functional (physiological) effects of a compound. Unlike current technology, the NNBS does not require recognition of predetermined molecular signatures, but reacts to any known or unknown compound that alters the function of the nervous system or kills cells. This ability positions the NNBS as a key element in homeland security and biowarfare countermeasures. *(2) Drug Development:* The NNBS will impact on the speed and cost of testing new pharmaceutical compounds by providing quantitative physiological data on effective concentration ranges and unexpected secondary binding of new molecules. It will provide a rapid screening of compounds and reduce animal experiments. (3) *Environmental and Industrial Toxicology:* Screening of new compounds and mixtures of known compounds can provide quantitative information on acute and chronic neurotoxicity and cell death and provide physiological guidance to subsequent animal experiments. *(4) Medical Research:* Antitoxin vaccine development has already been tested and unique investigations of disease states and physical trauma can be performed. *(5) Basic Network Neurobiology:* Understanding information processing in the brain requires knowledge of pattern processing in neural networks. Pattern processing depends on knowing the simultaneity of events that can be provided only by multielectrode recording. Knowledge of small network function is limited because high-density multielectrode probes destroy target tissues in animals. Nerve cell networks growing on electrode arrays eliminate this problem and allow continual long-term monitoring. *(6) Computer Science:* Basic principles of pattern generation and storage, origins of spontaneous activity, fault tolerance (i.e. continued function despite damage), self-organization, and emergent properties of dynamic systems can be investigated and modeled. A bumblebee with a neural mass no larger than the head of a pin outperforms present computers in the area of pattern recognition and sensory-motor coordination! Networks on electrode arrays allow systematic exploration of vital biological functions that can be modeled to support the development of more flexible, trainable computers.

Technology Development: Immediate efforts include (a) transition from single networks to multinetwork, parallel, high thru-put assay platforms, (b) improving reliability and stability of life support systems, (c) reducing the size of amplification and data analysis components, (d) exploring factors that enhance long-term stability of cell-electrode coupling, (e) investigating medium biochemistry, and (f) creating real-time data analysis programs and displays. Expansion to 8-network recording modules is being initiated with a small State of Texas Advanced Technology grant. Future scaling beyond eight networks is possible with multiple modules of eight wells. Expert system software must be developed for interactive robotic assays and to provide automated data summaries and displays.

Funding: This research has received support from DARPA, NIH, the Joint Vaccine Acquisition Program of the DoD, and the State of Texas. However, Center support is based entirely on grants. Such oscillating support levels have caused inefficiencies, delays, and lost opportunity due to concomitant instabilities in trained support personnel. All potential application areas require further development that necessitates highly trained personnel, enhanced electronics, fine mechanics, and software support. Funding levels of $220,000 per year for a minimum of 5 years are necessary for an optimum exploitation of this area. Potential funding Sources are: DARPA, NIH, NSF, CBMS, and Homeland Security. Experience and performance also qualifies the CNNS to upgrade to an NSF Science and Technology Center.

CNNS P.O. Box 305220, UNT Station, Denton, TX 76203 Tel: (940) 565-3615; FAX: (940) 565-4136, www.cnns.org gross@cnns.org