FY2009 Learning Technologies Grants Proposal
(COVER PAGE)

Project Information

Getting Students Out for a Bout: A Topographic Approach to Waistline Control
Project Title

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Project Director

Department of Foods and Nutrition
Requesting Department

$3,250
Amount Requested Year 1 (≤$15,000)

$0
Amount Requested Year 2 (≤$15,000)

Project Director's Signature

Proposal Endorsement Signatures

Department Head

Dean

Proposal Abstract (100-word maximum)

Funds are requested to purchase 24 heart rate monitors, 24 digital pedometers, 4 global positioning devices, and 4 barometric altimeters in order for students to gather data showing how observed rates of work (walking) on different areas and slopes on campus compare with calculations based on theory (an equation). Students will learn how to achieve the level of activity recommended by US dietary and health guidelines for preventing obesity. Students will participate actively in all aspects of scientific hypothesis testing and will learn to use statistical and bibliographic tools required by professional biomedical scholars.

Getting Students Out for a Bout: A Topographic Approach to Waistline Control

I. Project Description

A. The Nature of the Innovation:

This proposal will ask students to employ a detailed topographic map of the UGA campus for active learning about US guidelines for getting regular physical activity at a prescribed level of intensity. The equipment requested will enable students to take measurements of heart rate, physical work done, and vertical distance traveled at different speeds. For orientation, **topographic maps of the UGA campus** marking 2 ft elevations will be used (provided by Dr. Tommy Jordan of the Geography Department). Each group of 6 students will use a map along with a global positioning device (GPS) to plan routes and maintain uniform speeds while traversing the routes. They will gather data using heart rate monitors and existing accelerometers (to measure relative work done), and then analyze the (anonymous) data statistically in reference to a computational model using Microsoft Excel® software. Each student who participates will create and take home personalized charts (**Figure 1**) showing how her or his heart rate (relative rate of energy expenditure) changes as a function of walking speed and topography.

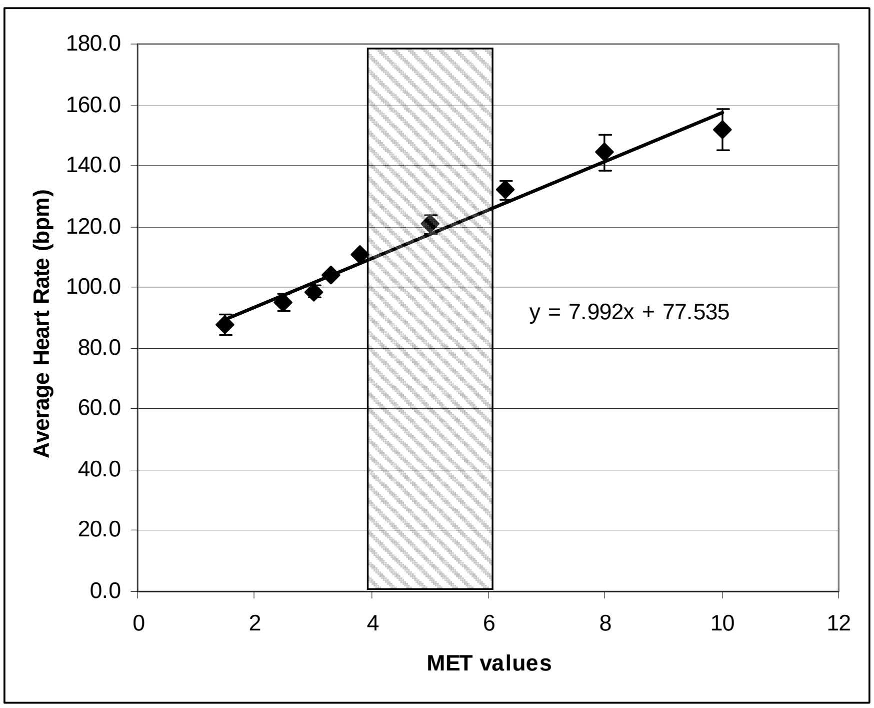

Figure 1. Example of average heart rates collected at walking rates of 2-6 mph on flat terrain plotted against relative metabolic rate (1 MET = lying at rest). Guidelines for physical activity suggest that all healthy people exercise in the 4-6 MET range for at least 30 min per day, and 60 min if weight reduction is desired. Note that students will obtain mean values, standard deviations, and a predictive trend line that intercepts the Y axis at the predicted resting heart rate. Data were analyzed and plotted with Microsoft Excel©

B. Need or rationale:
The didactic need that prompts this request is based on a program that I call "Tools of a Scholar." Many students in nutrition science need to conduct a research project that should include review of published biomedical literature to develop an hypothesis, use of bibliographic software (EndNote® is free on campus), collection of numerical data after institutional approval, analysis of data in reference to a model, and preparation of graphs using statistical software (Microsoft Excel is available in the computer laboratory). The completed report should be published through CURO, a newspaper, or a peer-reviewed journal. With the computational resources available, one only needs a means of acquiring meaningful numerical data at relatively low cost.

A program of walking 10,000 steps per day has been recommended as an accessible way of preventing weight gain and abdominal obesity. However, walking will not achieve a 4-5 fold increase in energy expenditure unless one walks very briskly or plans routes that include hills or stairs. If one has limited time and wishes to reach a specific goal for energy expenditure efficiently, it is very important to include vertical distance in the route. Unfortunately, very few people know the quantitative relationship, nor have many been taught to perceive when the proper training level is attained.

Voluntary energy expenditure is almost entirely physical work against gravity or friction. The equation is known but not taught in US nutrition courses. Specifically, 1 kcal equals 3,100 foot-pounds or 427 kg lifted 1 m against gravity at sea level. For better or worse, to reduce weight by 1 pound, one must expend about 3500 kcal, or perform **1.49 million kg-m of work**. One pound of fat contains roughly the energy needed to climb Mt. Rainier (14,000 ft) at a normal human efficiency of 20%. As Dave Barry says, I am not making this up. Clearly, an innovative plan for physically active learning is needed that cannot be achieved in the confines of a computer laboratory! An equation (a model) can be written to relate body mass, vertical distance, and efficiency to calories burned, which students can solve with a spreadsheet. However, one requires measured data to compare to the model equation.

Most adults gain weight at a rate of no more than 50 kcal per day, on average. 100 kcal is equivalent to about 0.028 lb of body mass, which is far too small to detect on a bathroom scale. A successful weight maintenance program calls for at least half an hour of effort each day at a rate about 4-5 times higher than resting metabolic rate. For most people, walking is the most accessible way to achieve this level, and heart rate is by far the simplest measure of relative energy expenditure.

Plan of action for the study
Several tools are available for planning routes that include enough vertical distance to achieve a 4-5 fold increase in energy expenditure. Topographic maps from the US Geological Survey do not give adequate detail. Therefore, I have asked Dr. Tommy Jordan of the Geography Department to prepare a UGA campus map with elevation contours. He has done this at no charge. The map shows that the Oconee River is about 600 feet above sea level, and that the hills on campus are about 700 feet above sea level. A person walking around the UGA track is on level ground and must walk very briskly to

achieve 4-5 METs, but this level of energy use can readily be achieved walking up or down hills.

Students will select 3 routes on campus that are of equal distance but differ in slope. They will record heart rates at 2 minute intervals while walking at 2 mph, 3 mph, and 4 mph as indicated by a GPS unit (with one pace setter per group of 6). Students will also wear accelerometers and the data will be transferred to a computer and saved in data files with anonymous codes lacking any identifiers.

Random numbers will be assigned for each student and all data for each student will be coded using the random numbers, with the instructor blinded to any identifiers except for gender. Coded data will be sent from the students to the assistant, who will save the data in a folder for later analysis by the instructor. During statistical analysis in class, all identifiers will be removed except gender and body mass, which will be necessary for the calculations. The data will be used to conduct a variety of comparisons and test various hypotheses about ways for students and faculty to attain the recommended level of daily physical activity during campus power-walking tours.

C. Relevance to unit and university priorities

One of the principle aims in the Department of Foods and Nutrition is to teach students how to optimize nutrition while avoiding unplanned weight gain. The Nutrition Science undergraduate major is dedicated to preparing students for successful application to graduate and professional careers in nutrition and/or the health sciences (medicine, pharmacy, nursing, dentistry, and allied fields). This project will teach the principle of human energy balance in a quantitative fashion. On a deeper level, it will teach the principles of scientific research beginning with generation of novel hypotheses and going to data collection, mathematical model-based analysis, and the need for publication.

As the biomedical initiative and new medical campus continue to be developed at UGA, this kind of quantitative, systematic approach to thinking will become ever more necessary for students who apply for graduate or professional training in health sciences. Indeed, a dominant theme in US health care is called evidence-based medicine. Students who complete the training outlined will readily grasp the principles of evidence-based health care.

D. Specific courses or student groups benefiting from the project

FDNS2400, Introduction to Nutrition Science (1 semester hour)
FDNS3100, Major Nutrients and Energy Balance (3 semester hours)
FDNS4550, Nutritional Biodynamics (3 semester hours)

E. Number of students served including undergraduate, graduate/professional or both

Approximately 120 undergraduates per year, with 24 active participants each in FDNS2400 and in FDNS4550.

II. Proposed Budget

Item	Quantity	Total Cost	Requested from LTG	Provided by other sources
Heart rate monitors, Reebok	**24@$50 ea**	**$1200**	**$1200**	
Pedometers, Omron	**24@$25 ea**	**$600**	**$600**	
Accelerometers, Actigraph	**12@$335**	**$4,020**	**0**	**Dr. Rick Lewis**
Global positioning units, Garmin 72	**4**	**$200**	**$800**	
Barometric altimeters	**4**	**$150**	**$600**	
Expert GPS software for Garmin72	**1**	**$50**	**$50**	
Total Request			**$3250**	

Budget justification narration

At least 12 accelerometers are required. These will be provided by Dr. Rick Lewis at no cost.

24 students will work in four groups of 6. Therefore, this request is for 24 watch style heart rate monitors to provide numerical data for effects of different levels of activity on level of exertion. For convenience, a model with no chest strap will be used.

24 pedometers are requested that provide steps taken, total distance, and a crude estimate of calories expended. It is important for students to travel the same distance at the same rate, and to have numerical values for analysis of group responses.

Each of the 4 groups will require one person to act as pacemaker, which will employ the highly accurate Garmin 72 GPS. This is an inexpensive model that has a gray scale screen rather than a color screen. This unit also allows track data to be stored separately and downloaded to a computer, where it can be overlaid onto a map (such as Google Earth). Computer interface cables are requested for each unit (included in quotation above).

1 copy of Expert GPS software is requested to enable tracks to be plotted.

4 electronic altimeters are requested. Each group of students will include one person who tracks change in vertical distance traveled using an electronic altimeter in conjunction with the topographic map. This is required because work against gravity can be calculated if vertical distance traveled is known.

Timeline

Date (mm/yy)	Objective	Person responsible
09/08	Develop study questionnaire	JLH
09/08	Institutional review	JLH
09/08	Obtain topographic maps	JLH from Tommy Jordan
10/08	Review equipment usage	JLH/Rick Lewis lab
10/08-11/08	Preliminary study FDNS2400	JLH with Thom Shaffer (senior undergraduate)
12/08	Obtain funding, equipment	JLH through CAIT
01/09	Continue in FDNS4550	JLH with Thom Shaffer
01/09	Submit CURO abstract	Thom Shaffer
02/09	Complete first full trial	JLH with Thom Shaffer
03/09	Consider full publication	
03/09	Use data for FDNS3100 workshop	JLH
03/09 to 12/09	Evaluate related hypotheses for teaching in future classes	JLH

A preliminary study will be done in FDNS2400 during Fall 2008 using the accelerometers from Dr. Lewis along with the instructor's GPS unit. Heart rate will be monitored manually using a watch instead of getting immediate readout from a digital device. Dr. Jordan has already provided a topographic map for the area from the UGA track past Dawson Hall to the football stadium.

Because it may not be feasible to obtain the requested equipment in time for this semester, the full study will be done beginning in Spring 2009 in FDNS4550, which utilizes a computer laboratory in order to do modeling with Microsoft Excel. Variations on the concept explained will be carried out in future years.

III. Learning Outcomes

Specific learning outcomes will include:

1. Knowledge of how to compare data from measurements with predictions from theory (expressed as one or more equations that can be solved using a spreadsheet). The data to be analyzed will be obtained using the requested equipment.
2. An understanding from hands-on experience that the degree of variability in any kind of measurement requires statistical analysis.
3. A practical understanding of the US guidelines for daily physical activity as experienced by personal monitoring at different rates of work.
4. Knowledge that any study requires a great deal of planning and a need to obtain institutional approval, and that new results have little value until they are published.

Methods for evaluating the learning outcomes

1. Participating students will answer pre- and post-study questionnaires to determine whether they understood the quantitative relationship between physical activity and energy (kcal) expenditure.
2. All students will analyze the data using Microsoft Excel and will describe the outcomes in writing. Their projects will be turned in for the instructor to evaluate.
3. Students will review US guidelines for physical activity in view of their outcome measures. The written part of the project will include a request for personal reflection concerning what was learned.
4. The highest test of success would be presentation of the work at a CURO symposium and/or completion of a senior thesis on the basis of this study.

Potential applications in other academic areas

1. The principle application in other academic areas is that students will understand how to formulate a quantitative hypothesis in reference to an equation, and will be able to solve any equation encountered in courses such as biochemistry and physiology.
2. Students will also understand how to use Excel to prepare graphs and to use bibliographic software for writing projects in other courses.
3. Similar methods are used for specific purposes by investigators in the Department of Kinesiology. The methods are potentially applicable in public health and any other behavioral health science.

IV. Support plan

JLH will take responsibility for maintaining the equipment and software, which is specialized and is not supported by UGA or the College of Family and Consumer Sciences. Batteries will be removed from all electronic equipment so the monitors can be reused by future classes.