

## **2005-2007 LITRE Grant Proposal**

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### **1. Project Title:**

Nutritional analysis web site

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### **2. Project Coordinator:**

**First Name:** Jonathan

**Last Name:** Allen

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### **3. Other Participants:**

Dr. Sarah Ash, Nutrition Undergraduate Coordinator

Bernard Eckhart, TECHNICAL SUPPORT ANALYST, Department of Food Science

Gary Matsey, NTR 301 Instructor

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### **4. College or Unit:**

College of Agriculture and Life Sciences

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### **5. Department:**

Food Science, Interdepartmental Nutrition Program

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### **6. Project Description:**

This project will create a Web-based diet analysis program adequate for use as a homework assignment in several courses in the Nutrition curriculum to promote student understanding of the relation between energy intake and expenditure. The program will be available for long-term use by students to manage their own eating behavior and body weight and as a refresher on sound principles of nutrition. Planned improvements to the program will allow its use in more courses and by more students, and expand the educational capabilities.

The project will start by automating a workbook that has been used successfully as a homework assignment in NTR/FS 400 (Principles of Human Nutrition) for several years. The workbook requires students to analyze their personal diet for a 7-day time period and calculate their energy expenditure for basal metabolism, normal activity, purposeful exercise and diet-induced thermogenesis (energy cost of eating). They use a diet diary and analysis program we have developed to evaluate potential deficiencies and excesses in their personal diet. Student course evaluations have rated the workbook as one of the most valuable parts of the course. However, students experience frustration because the Website is slow to load and only supports 5-10

students on any page at one time. This is because, for budgetary reasons, the programming was done in a Microsoft Access database and ASP programming language that requires the Microsoft Internet Explorer browser for full functionality. These limitations prevent more extensive use of this programming technology to enhance student learning in other aspects of nutrition courses, such as allowing students to work with the database developed from the whole class to analyze micronutrient intake or different food selection patterns.

This LITRE grant will support a programmer for the following objectives: (1) convert the diet analysis to full functionality for unlimited simultaneous users by translating to the PHP programming language and a SQL database; (2) create a JavaScript web page to automate the existing energy expenditure workbook so that students get immediate feedback if they enter incorrect calculations, and their personal data will be displayed graphically to allow them to visualize the channels for their energy expenditure; (3) modify the diet analysis program to provide more information on micronutrients; (4) add a component to the diet analysis program to provide output as food group or food exchange distribution as well as individual nutrients.

The format of the current diet diary and diet analysis was developed by Gary Matsey as a component of his PhD research in the Nutrition Program. The program has been used for 3 years by students in NTR/FS 400. The diet diary page incorporates a layout that enables the user to enter or view a complete day's diet and exercise history in comparison to goals and current dietary status. The website browser window has a column containing three units marked "Goals", "Actual", and "Weekly Score." The "Goals" unit is where the goals for calorie intake, exercise calories burned, rate of weight loss, and target weight are displayed. Goals are set within the first week of using the diet diary. The "Actual" unit displays the user's actual total caloric intake and calories burned from exercise. These are totaled for each day and displayed with the user's current weight. The "Weekly Average" unit displays the weekly average for caloric intake and exercise calories based on the actual number of days for which data has been entered up to 7 days.

To the right of the "Goals", "Actual", and "Weekly Score" column are the dietary and exercise input and history units, divided by meal and a comment box. Calories for each food entered into the Diet Diary are displayed by item and meal under the appropriate meal heading (Breakfast, Lunch, Snack, Dinner). Calories expended by exercise activity are listed by each exercise entered. Actual total caloric intake and calories burned from exercise are totaled for each day and displayed with the users current weight as part of a display box marked "Actual". A weekly average for caloric intake and exercise calories is also displayed under the heading "Weekly Score", based on the actual number of days for which data has been entered, up to 7 days. Dietary intake is recorded by the user, using an on-line database featuring the United States Department of Agriculture (USDA) Food Database. However, the user is not restricted to the USDA database as they can enter their own foods into a personal database under the Custom Foods page, using an entry form designed to resemble the Nutrition Facts Label on a food package. This design was chosen to encourage a better understanding of the Nutrition Facts Label with each use because research has shown that repeated use of the Nutrition

Facts label has been associated with a lower fat intake (Neuhouser et al., 1999). Exercise activity is recorded by selecting from a list of exercises, level of activity, and event duration from a database that incorporates the Compendium of Sports Activity (Ainsworth et al., 1993).

By comparing the data from the “Goals”, “Actual”, and “Weekly Score” units to the diet and exercise history units, the user can visually see how they are doing every time they visit the Diet Diary. In addition, they can see at a glance where their calories are coming from by meal and by food item. This design also has the advantage of only reporting the most basic of information necessary for the user to interpret their diet. To gain a more detailed analysis, students are directed to a data analysis program,

The analysis program allows students to analyze the information in their Diet Diary by food, meal, day, week or month. Analysis consists of a Summary page containing a Calories Per Day Table, a Percent of Goals bar chart, a Percent of Total Calories intake pie chart, and a Nutrient Report for the foods they've entered for analysis. The Calories per Day table gives a numerical comparison of Goals they have set versus Actual input for Calories per day, Calories from Fat intake per day, and Exercise Calories Burned per day, as well as the difference between the two. The Percent of Goals bar chart is a graphical representation of how close users are to reaching or exceeding the goals they have set for total calorie intake, and preset goals for total fat, carbohydrate, and protein intake based on the Dietary Guidelines. The Percent of Total Calories pie chart demonstrates what percentage of fat, carbohydrate, and protein makes up the users total intake for a quick reference on how they are doing regarding the Dietary Guidelines. The Nutrient Report provides the user with an analysis of the total macronutrient and selected micronutrient content of their foods as would be displayed on a Nutrition Facts Label, including grams, calories, percent of goal, percent of total calories, and recommended percent of total calories based on the Dietary Guidelines.

Two additional features of the Diet Diary analysis page are the foods list and weight history displays. The Food List display shows all foods entered for the time period being analyzed. This list reports macro and micronutrient content of foods recorded into the Diet Diary for each individual food entered, displaying the same information visible on a Nutrition Facts Label. This list can be ordered by clicking on a heading, making it easy for a user to identify a food that was highest in fat, saturated fat, or vitamin A. The user can also click on a food to see what date it was entered in the diet diary, and then click on the date(s) displayed. The diet diary will change to the date so the user can review entries recorded there and help pinpoint excess intake by identifying multiple entries for a single food item. The Weight History display shows a weekly progress report on the user's weight graphically displayed as a bar chart. Participants can record their weight every week into the Diet Diary and then see it displayed for comparison to the target weight they choose when they set their personal goals. As a result, the user can watch their weight change over time in comparison to their target weight to encourage and support weight loss.

Thus, we have already completed a phase 1 project with substantial student testing. The next generation of this program will correct problems we have encountered, chiefly speed, ease of use, and automation of the workbooks for

homework. The diet analysis program will be maintained on our own dedicated server in the Food Science department. The rewritten program will have increased security of students' personal diet data. The program will be available to students to continue their learning about foods and nutrition in subsequent courses by having access to the program to assess changes in their diet or those of others, such as when students work or volunteer in a community service environment. A link to the program from the nutrition program website will provide a recruiting tool for our courses.

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## **7. Project Objectives:**

(1) Convert the diet analysis to full functionality for unlimited simultaneous users by translating to the PHP programming language and a SQL database. This objective will enable students to evaluate the nutritional adequacy of their personal diet. The new program will have capacity for the current and future enrollment in the course that now use and may adopt the technology. Students will be required to critically evaluate the results generated by the computer analysis, and identify the limitations imposed by their accuracy of data collection, the accuracy and limitations of the USDA database, and the variation in individual requirements.

(2) Automate the existing energy expenditure workbook so that students get immediate feedback if they enter incorrect calculations, and their personal data will be displayed graphically to allow them to visualize the channels for their energy expenditure. This program will enable students to become familiar with the quantitative relationships among diet, exercise and weight control. By hosting these course programs on a server outside the WebCT or Wolfware environment, students will be able to manage their own diet and exercise for personal health beyond the scope of one course. The data entered can be carried forward over a multi semester course sequence. Students engaged in community service projects through our External Learning Experience course will have access to the diet analysis program to help others in the community much like a professional dietician does.

(3) Modify the diet analysis program to provide more information on micronutrients. As enrollment in the Nutrition curriculum grows (it has increased from 30 to 120 students in the last 5 years, with expected growth to 175) there is a need for additional courses. One plan is to split our existing survey course (NTR 400/500) into a 2-semester sequence for more depth on Macronutrients and exercise (semester 1) and Micronutrients (semester 2). Computerized diet analysis will enable students to evaluate micronutrient intake from a dataset comprising their diet and those of their classmates to evaluate the risk of micronutrient excess or deficiency using some basic tools of statistical analysis and nutritional epidemiology.

(4) Add a component to the diet analysis program to provide output as food groups or food exchange distribution as well as individual nutrients. A varied diet is the simplest way for consumers to avoid nutritional problems. Software for use by our consumer-level nutrition courses (e.g. NTR 301) should illustrate diet variation according to the well-recognized food group or exchange systems, such as the Food Guide Pyramid. This is not easy to automate due

to the prevalence of foods comprising portions of multiple food groups, such as a pizza. This problem will be addressed in the second year by developing appropriate algorithms or adding an identifier to the food database.

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#### **8. Estimated number of students affected:**

Use in NTR/FS 400/500 (taught by Allen) impacts approximately 100 students per year. Adoption of some portion of this program in NTR 301 will impact approximately 100 students during summer sessions (taught by Matsey) and 400 students per semester during Fall and Spring terms (taught by Ash). Additional impact could be made on the health of other NCSU students interested in personal diet and weight management.

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#### **9. Outcomes of the Project:**

- (1) Students will learn the impact of specific food choices on the nutrient quality of their diet.
  - (2) Students will understand and visualize the relative importance of basal metabolism, exercise, and digestion on energy expenditure and body weight. They will calculate the effect of cessation of exercise if they transition to a more sedentary lifestyle in later life on potential weight gain or impact on diet.
  - (3) Students will learn to evaluate diets of other students, working in a team setting, and manipulate a dataset that includes their own input, thereby understanding the different use of nutritional guidelines in assessment of an individual and assessment of a population. The team will apply statistical concepts learned in other courses to nutritional data collected in this course. This project will make assignments and interactions that have worked well in face-to-face sections applicable to students in Distance Education sections as well.
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#### **10. Project impact on NCSU:**

Keeping the diet analysis website open to students after they leave the course will potentially improve their personal nutrition and health in the long term. A link to the program from the departmental website will increase our visibility in the community and help with recruiting efforts of students interested in nutrition. If our students continue to use this program in volunteer and internship positions, the project will be providing a valuable service to the community and other the health of other students.

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#### **11. Project Assessment Plan:**

- (1). Students will learn the impact of specific food choices on the nutrient quality of their diet.
  - o Using written answers to specific questions in their on-line workbook submission, students will identify potential deficiency and excesses in their diet, and differentiate between errors in data collection, data entry, and database adequacy, and true dietary problems.

(2). Students will understand and visualize the relative importance of basal metabolism, exercise, and digestion on energy expenditure and body weight. They will calculate the effect of cessation of exercise if they transition to a more sedentary lifestyle in later life on potential weight gain or impact on diet.

- o Knowledge and understanding of these areas in the discipline of nutrition as gained from the program will be tested in the quiz on the energy metabolism unit and on the comprehensive final exam.

(3). Students will learn to evaluate diets of other students, working in a team setting, and manipulate a dataset that includes their own input, thereby understanding the different use of nutritional guidelines in assessment of an individual and assessment of a population. The team will apply statistical concepts learned in other courses to nutritional data collected in this course. This project will make assignments and interactions that have worked well in face-to-face sections applicable to students in Distance Education sections as well.

- o The diet analysis program is written to enable the project coordinator to track student use for an indefinite amount of time. Current we track when each page is visited and the amount of time spent there. Use of the program for personal or consulting purposes by students after they complete the course assignment will be quantified. Such use will indicate that the students have mastered the concepts of diet assessment and find the tool valuable in their personal life or in consulting or community service projects.

- o Students working in groups will comment on the contributions of other students in their group in a report. The team will report on inferences obtained from the class data in more depth than the individual students are able to get from their personal diet data.

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## **12. Staffing and Support:**

The PI will hire a Computer Science graduate or student with experience in PHP, Javascript and SQL to write the nutritional analysis software and develop the workbooks into a an interactive webpage. A student who has already worked on this project during Summer 2005 has an interest in continuing.

2005-2006: (25 wk x 20 hr/wk x \$15/hr) + 8.58% fringe benefits = \$8144

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## **13. Financial Support Requested:**

**EPA salary total:**

**SPA salary total:**

**Other salary:** 8144

**Equipment:** 925

**Cost associated with assessment:**

**Other financial support requested:**

**Total Funds requested:** 9069

**Additional Explanation of how funds will be used:**

Equipment: \$475 for backup hard drive, \$425 for additional RAM.

Department will furnish computer for use as server, server software and any additional software needed.

**14. Funding Breakdown:**

**Total funding requested for fiscal year 2005-2006:** 9069

**Total funding requested for fiscal year 2006-2007:**

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**15. Staff Support and/or Technical Support Requested:**

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**16. Timetable for Implementation:**

Objective 1 and 2 will be completed by March 2006 for testing during the Spring section of NTR 500. Objectives 3 and 4 will be completed by June 2006 for use in the summer section of NTR 301.

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**17. Human Subjects Protection:**

If your proposal project involves research using human subjects, you will need approval from the Institutional Review Board for the Protection of Human Subjects in Research (IRB) prior to final approval. IRB information is available at <http://www.ncsu.edu/sparcs/irb>



**18. Proposal Release:**

By submitting this proposal the applicant grants the LITRE Advisory Board permission to make this proposal available as an example for future grant applicants. All personal information will be removed if this proposal is used as an example.

