THE FACULTY SENATE

December 17, 2007

MEMORANDUM

TO: Dr. Eddie J. Davis, Interim President

FROM: Angie Hill Price, Speaker

SUBJECT: Approval of Graduate Council Item (FS.25.82)

At its regular meeting on December 10, 2007, the Faculty Senate approved the following curriculum item from the Graduate Council. The Faculty Senate submits it for your approval. Attached is a copy of the material sent to our Senators.

Special Consideration – November 20, 2007

Collaborative effort of Departments of Nutrition & Food Science,
Kinesiology & Nuclear Engineering
Certificate in Space Life Sciences

Thank you for your time and consideration. Please inform me of your action on this matter.

Attachment

cc: Jerry Strawser
Karan Watson
Paul Meyer
Sandra Williams
Robert Webb
Elsa Murano
Kemble Bennett

Approved:

[Signature]

Dr. Eddie J. Davis, Interim President

[Signature]

Elsa A. Murano, Ph.D.

Date
January 30, 2007

TO: Dr. Elsa A. Murano
President

SUBJECT: FS.25.82 Collaborative Effort of Departments of Nutrition and Food Science, Kinesiology and Nuclear Engineering

I recommend approval of the Certificate in Space Life Sciences. This innovative program represents an interesting collaboration involving the Departments of Nutrition and Food Science, Kinesiology, and Nuclear Engineering. And the program is supported by external funding.

Students will do this certificate program while working on a Ph.D. in Nutrition and Food Sciences, Kinesiology, or Nuclear Engineering. We are increasingly seeing both undergraduate and graduate certificates of this type, which represent specialized training in an area beyond the major. In some ways a certificate program like this is like a minor. However, a certificate, unlike a minor, is separately recorded on the student’s transcript, which has some marketing advantages.

The approval process for certificate programs varies. The process depends on the length of the certificate, the level of courses, the particular discipline and how it relates to existing programs, and whether the certificate is going to be offered externally as a stand-alone certificate program. Some certificates can be approved at the campus level. Some must also receive approval from the Board of Regents, the Texas Higher Education Coordinating Board, and/ or our regional accrediting agency, SACS.

This certificate program is in the category that will require Coordinating Board notification with automatic approval subject to review. (See highlighted section of attached rules).

If you approve this program, we will accordingly assume approval, but send copies of the proposal to both the Board of Regents and the Coordinating Board for notification and review purposes.

Jerry R. Strawser
Interim Executive Vice President
and Provost

Attachments
Coordinating Board Rules.

From Chapter 5. Rules Applying to Public Universities and/or Health-Related Institutions of Higher Education in Texas.

Subchapter C. Approval of New Academic Programs and Administrative Changes at Public Universities and/or Health-Related Institutions.

§5.48 Criteria for Certificate Programs at Universities and Health-Related Institutions

(a) Universities and health-related institutions are encouraged to develop upper-division and graduate certificate programs of less than degree length to meet the needs of students and the workforce. These rules are intended to provide a streamlined process for approval of those programs.

(b) Certificate programs for which no academic credit is granted are exempt from the provisions of this section.

(c) Certificate programs for which academic credit is granted at universities and health-related institutions must meet the following criteria:

1. They must meet identified workforce needs or provide the student with skills and/or knowledge that shall be useful for their lives or careers.

2. They must be consistent with the standards of the Commission on Colleges of the Southern Association of Colleges and Schools.

3. They must meet the standards of all relevant state agencies or licensing bodies which have oversight over the certificate program or graduate.

4. Adequate financing must be available to cover all new costs to the institution five years after the implementation of the program.

(d) The following certificate programs do not require Board approval:

1. Certificate programs for which no collegiate academic credit is given,

2. Certificate programs in areas and at levels authorized by the table of programs of the institution with curricula of the following length:

   A. At the undergraduate level of 20 semester credit hours or less,

   B. At the graduate and professional level of 15 semester credit hours or less.

(e) The following certificate programs require only Board notification and are automatically approved, subject to review:

1. Upper-level undergraduate certificates of 21-36 hours in disciplinary areas where the institution already offers an undergraduate degree program.

2. Graduate-level and professional certificates of 16 - 29 hours in disciplinary areas where the institution already offers a graduate program at the same level as the certificate.

(f) Lower-division certificate programs.

1. One and two-year, post-secondary workforce education programs should be delivered primarily by community, state, and technical colleges. These institutions are uniquely suited by virtue of their specialized mission, local governance, and student support services to provide such opportunities in an efficient and economical manner. For that reason, new lower-division certification programs shall not generally be approved at public universities and health-related institutions.
(2) Universities and health-related institutions should not develop certificate programs at the upper or graduate level that are equivalent to lower-division certificate programs offered at community, state, and technical colleges.

Source Note: The provisions of this §5.48 adopted to be effective May 28, 2003, 28 TexReg 4125
September 10, 2007

TO: Dr. Robert C. Webb
Interim Dean of Graduate Studies

THROUGH: Dr. Gene A. Nelson
Executive Associate Dean of COALS

THROUGH: Dr. David W. Reed
Chair, COALS Graduate Program Council

THROUGH: Dr. Michael I. McBurney
Head, Nutrition & Food Science Department

Dr. James M. Eddy
Interim Head, Health and Kinesiology Department

Dr. Raymond J. Juzaitis
Head, Nuclear Engineering Department

FROM: Dr. Joanne R. Lupton

Dr. Nancy D. Turner
Co-Director’s of the Space Life Sciences Training Program

SUBJECT: Approved of Certificate in Space Life Sciences

Enclosed is a proposal to create a Certificate in Space Life Sciences. The Certificate supports a National Space Biomedical Research Institute (NSBRI)-sponsored training program targeted at the education of Ph.D. students in critical areas of space life sciences, with an emphasis on cross training in the areas of Kinesiology, Nuclear Engineering and Nutrition. The program is funded for 6 years and we will be pursuing continued funding in the future. The proposal includes the development of two new cross-listed courses: KINE/NUEN/NUTR 689 – Fundamentals in Space Life Sciences, and KINE/NUEN/NUTR 681 – Space Life Sciences Seminar. In addition, students must complete coursework in the two areas outside of their major, an ethics course, participate in experiential learning opportunities off campus, and receive training in communicating with the public at large, for a total of 17 hours additional credits. The specifics of the requirements are outlined in the accompanying proposal.

We appreciate your assistance in the review, approval and subsequent forwarding of these documents through to the Office of Graduate Studies for final consideration. If you would like any additional information or have questions or comments, please contact Dr. Nancy Turner by phone (847-8714) or e-mail (n-turner@tamu.edu).
Proposal

For a

Certificate in Space Life Sciences
Doctoral degree programs in Kinesiology, Nuclear Engineering
(Health Physics) and Nutrition ONLY

Department of Kinesiology
College of Education

Department of Nuclear Engineering
College of Engineering

Department of Nutrition and Food Science
College of Agriculture and Life Sciences

Texas A&M University
College Station, Texas

September, 2007
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PART I: Program Description

Purpose

Emphasis has been placed on NASA to explore the solar system and return humans to the Moon by 2020 in preparation for human exploration of Mars and other destinations (NASA, 2004). To send astronauts safely to the Moon and Mars requires a nationally coordinated effort with targeted goals and priorities for achieving those goals. NASA/NSBRI has developed a Bioastronautics Roadmap designed to identify the biomedical and health risk of spaceflight, and to identify research questions that must be answered to reduce those risks (NASA, 2005). Success will require an increase in the community of scientists trained in these critical areas to solve the complex biomedical research questions associated with achieving safe, long-duration space flight (NASA, 2003).

The overall goal of the Certificate in Space Life Sciences is to develop a cadre of scientists capable of performing the work necessary to solve three of the most critical problems in space life sciences that limit long duration space flight: 1) bone loss 2) muscle wasting and 3) effects of cosmic radiation. To fulfill this goal, the Departments of Nutrition and Food Science, Health and Kinesiology, and Nuclear Engineering, propose to create a Certificate in Space Sciences. The four part approach for certification is designed to provide graduates with an integrated global perspective on these major biological problems of long duration space flight and provide the specific training in either nutritional and/or exercise physiology countermeasures against them. Students seeking each of the three degrees will have a broad knowledge of all major issues facing long duration space flight and specific additional knowledge of the other two degrees. This is achieved through several classes that all students will have in common: a required cornerstone course, a joint seminar, ethics class, and required “experiential class” -- a rotation at NASA/JSC and a rotation at the University of Texas Medical Branch and/or Brookhaven National Laboratory. Trainees who complete the program will have a solid grounding in research, teaching and service to have successful careers in academia, with NASA, private industry partners in the space initiative, and/or other public or private organizations involved in NASA’s space exploration endeavors.

Advisory and Mentoring Committee for the Certificate in Space Life Sciences

The advisory and mentoring committee is comprised of three members of the graduate faculty, each representing the three individual disciplines, Kinesiology, Nuclear Engineering and Nutrition. The committee members are selected from those on the graduate program and complete a three year term before rotating within their particular discipline.

The committee will monitor students’ progression through the program, facilitate any issues that may arise between research mentor and graduate student with respect to timeliness, research expectations, etc., review each students degree program, and confirm they satisfy the requirements for the certificate program. Applicants can discuss potential mentors with advisory committee mentors relevant to their research. If a graduate student wishes to seek advice from faculty outside their program, we will provide that opportunity for them.

Award of the Certificate in Space Life Sciences

The Dean for the College of Agriculture and Life Sciences will sign the Certificate in Space Life Sciences. The Certificate will be awarded after the student has completed the requirements for the certificate and the specific degree for which they are involved, Kinesiology, Nuclear Engineering or
Nutrition. Once the student has completed these requirements, a Certificate in Space Life Sciences will be noted on the trainees' official University transcript in addition to grades for the courses taken to fulfill the requirements of the certificate.

PART II: Admission Criteria and Course Requirements

A. Criteria for Selection into the Training Program

The admissions committee consists of faculty from each of the three degree-granting entities. The admissions committee will coordinate with the admissions committees for each of the respective degree-granting departments/faculties. Student selection will be based on the student's academic potential, training, interest, and commitment to entering the Texas A&M University Space Life Sciences Ph.D. Program.

For consideration into the program, a student applicant must have a strong interest in space life sciences and submit the following documents that will be reviewed by the admissions committee: 1) an Application for the Ph.D. Training Program in Space Life Sciences (please see Appendix A), 2) Texas A&M University graduate application, 3) letters of recommendation, 4) university transcripts, 5) letter of support for the applicant from the graduate student's mentor, and 6) a written essay (2 to 3 pages) describing potential research and career goals, and how the Ph.D. program in Space Life Sciences will help them achieve their goals. Students with the highest potential will be invited to campus to meet with teaching and research faculty and with student organizations as appropriate.

Criteria for selection includes completion of a bachelor's or master's degree at an accredited university and a minimum 3.0 GPA on a 4.0 total scale. In addition, all students must be accepted into a doctoral program in one of three disciplines, Kinesiology, Nuclear Engineering, or Nutrition.

B. Requirements to obtain the Certificate in Space Life Sciences

Each of the three Ph.D. degree granting programs has its own requirements for the degree which all students seeking that degree must fulfill. Doctoral students are expected to complete 96 hours beyond a bachelor's degree or 64 hours beyond a master's degree; to pass a qualifying exam; and to defend their dissertation. For a brief description of each degree please see Appendix B.

To meet requirements to obtain a Certificate in Space Life Sciences, students will earn a minimum of 17 credit hours, 11 credit hours from mandatory courses and an additional 6 credit hours from experiential training programs (NASA/JSC, UTMB, Brookhaven National Laboratory) (Table 1). If a student chooses to participate in all three experiential training programs, they could earn a total of 20 credit hours; however, this is not required to obtain the Certificate.
<table>
<thead>
<tr>
<th>Mandatory courses/training programs</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Space Life Sciences (KINE 646, NUEN 646, NUTR 646) (Submitted, please see Appendix D)</td>
<td>3</td>
</tr>
<tr>
<td>Scientific Ethics (VMID 686)</td>
<td>1</td>
</tr>
<tr>
<td>Seminar in Space Life Sciences (KINE 681, NUEN 681, NUTR 681)</td>
<td>1</td>
</tr>
<tr>
<td>Two courses outside the students discipline</td>
<td>6</td>
</tr>
<tr>
<td>Applied Exercise Physiology (KINE 649)</td>
<td></td>
</tr>
<tr>
<td>Microdosimetry (NUEN 615)</td>
<td></td>
</tr>
<tr>
<td>Nutritional Biochemistry 1 (NUTR 641)</td>
<td></td>
</tr>
<tr>
<td>Two Directed Studies (minimum) (KINE 685, NUEN 685, NUTR 685)</td>
<td>6</td>
</tr>
<tr>
<td>NASA/Johnson Space Center</td>
<td></td>
</tr>
<tr>
<td>The University of Texas Medical Branch</td>
<td></td>
</tr>
<tr>
<td>Brookhaven National Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

Total 17 units

**Courses.** The syllabus for each course, including the two new courses are found in the Appendix C. All trainees will be expected to take two new approved courses, Fundamentals of Space Life Sciences (submitted, please see Appendix D) and the Space Life Sciences Seminar (please see Appendix C). In addition to completing a course in Scientific Ethics, students are required to take one course in each of the two disciplines other than the primary degree sought by the student, i.e. NUTR 641 (for NUEN and KINE); KINE 649 (for NUTR and NUEN); and NUEN 615 (for NUTR and KINE).

**Research.** All trainees must successfully defend a dissertation related to space life sciences. Students will work with a strong research core of space life scientists at Texas A&M, UTMB, NASA/JSC and Brookhaven National Laboratory who are working on issues critical to the success of long duration space flight, i.e. muscle loss, bone loss and radiation-enhanced cancer and countermeasures against these critical problems (diet and exercise).

**Experiential Component.** KINE 685, NUEN 685, NUTR 685 (3 units each). All trainees must complete the experiential component at NASA Johnson Space Center (JSC) and one of the other two experiential components (i.e., Brookhaven National Laboratory for the degree in Nuclear Engineering; the rotation at UTMB for the degree in Kinesiology or Nutrition). However, participants may select to take part in all three experiential training sessions.

**Teaching/Service Component.** All trainees must successfully complete a teaching/outreach component which could include giving lectures to middle/high school classes, preparing a streaming video to be used in other classroom settings, and participating in workshops/seminars held by the Center for Teaching Excellence.
PART III: Integrated Components Required by the Texas A&M University Ph.D. Training Program in Space Life Sciences (TAMU-SLS) for a Certificate in Space Life Sciences

A. Mandatory Courses

Trainees obtaining a Certificate in Space Life Sciences will be required to take three mandatory core courses (9 units), plus an ethics course (1 unit) and a seminar (1 unit). In addition, a trainee will participate in a minimum of 2 experiential training programs (6 units). Copies of the syllabi for each mandatory course are shown in Appendix C.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>KINE/NUEN/NUTR 646</td>
<td>Fundamentals of Space Life Sciences (submitted, please see Appendix D)</td>
</tr>
<tr>
<td>KINE/NUEN/NUTR 681</td>
<td>Seminar</td>
</tr>
<tr>
<td>VMID 686</td>
<td>Scientific Ethics</td>
</tr>
<tr>
<td>KINE 649</td>
<td>Applied Exercise Physiology (NUEN and NUTR students only)</td>
</tr>
<tr>
<td>NUEN 615</td>
<td>Theory and Applications of Microdosimetry (KINE and NUTR students only)</td>
</tr>
<tr>
<td>NUTR 641</td>
<td>Nutritional Biochemistry I (KINE and NUEN students only)</td>
</tr>
<tr>
<td>KINE/NUEN/NUTR 685</td>
<td>Directed Studies</td>
</tr>
</tbody>
</table>

The courses are listed on the Texas A&M University Office of Admission and Records web site at http://courses.tamu.edu.

B. Course Description

**Fundamentals of Space Life Sciences (submitted, please see Appendix D).** KINE 646, NUEN 646, NUTR 646 (3 units). Provides an introduction to the many space life sciences issues associated with long duration space flight. Students will have an appreciation of the many different issues that do not directly relate to their own particular degree/research program. Topics to be covered include Space Physiology (e.g., space environment, musculo-skeletal system, cardiovascular system, exercise and research methods and techniques), Space Nutrition (e.g., nutritional requirements, ground based research models, effect of microgravity on specific requirements, role of nutrition in mediating bone and muscle wasting and radiation exposures), and Space Radiation (e.g., complex radiation environment, detection, biological effects of low- and high-LET radiation, countermeasures).

**Scientific Ethics.** VMID 686 (1 unit). The course is an overview of ethical issues encountered by scientists in the conduct and dissemination of their research, in their pursuit of resources, in their interactions with the press and the broad public, and resulting from the extension and technological application of their findings.

**Seminar in Space Life Sciences.** KINE 681, NUEN 681, NUTR 681 (1 unit). This seminar course “Seminar in Space Life Sciences” will be cross-listed and will be used to further
foster opportunities for learning. Students and mentors discuss current research in Space Life Sciences and invited lectures, the most eminent researchers in the field, will lecture to further opportunities for learning and encourage student participation.

One course each in the two degree programs other than the one sought by the Ph.D. Student.

**Applied Exercise Physiology. KINE 649 (3 units).** Covers how environmental factors (temperature, altitude, microgravity), development, aging, and gender alter the physiological responses to acute exercise and chronic physiological adaptations to exercise training. Students will understand the mechanisms responsible for the physiological responses and adaptations that occur in response to varying environmental conditions, and gain a basic understanding of the pathophysiology of cardiovascular, metabolic, and bone diseases and the physiological role of exercise in prevention and/or treatment of these diseases.

**Microdosimetry. NUEN 615 (3 units).** Acquire a working understanding of the physical and stochastic nature of radiation exposure at low doses, an appreciation for the significance of these properties as they influence the response of physical and biological systems to low dose and dose rate exposures, and an understanding of the methods used for evaluating energy deposition at low doses. The course will cover the processes involved in energy deposition, the definitions of microdosimetric quantities, mathematical simulation, measurement methods and instrumentation, data analysis, and applications including radiation protection and risk estimation.

**Nutritional Biochemistry I. NUTR 641 (3 units).** Covers mechanisms of intestinal absorption of nutrients. Integration of the intermediary metabolism of glucose, amino acids, lipids with nutrition, physiology, and pathophysiology in animals. Regulation of metabolic pathways in cells, tissues, and the whole body under normal and disease conditions. Functions of vitamins and minerals in nutrient metabolism and health.

C. Experiential Components

i. Overview of the Experiential Training

Individuals at NASA/JSC, The University of Texas Medical Branch at Galveston (UTMB) and Brookhaven National Laboratory will facilitate training opportunities using research tools and techniques not available on the Texas A&M campus. Each student will complete a training program at NASA/Johnson Space Center during the summer of their first year in the graduate program. They will then be required to do one other offsite training, the choice depending upon their research program. For example, students in Nuclear Engineering will be required to go to Brookhaven National Laboratory while students majoring in Nutrition and Kinesiology will be required to go to UTMB. During the second summer of the training program, students will need to have taken all mandatory core certificate courses before participating in the experiential learning opportunities (Brookhaven, NASA, UTMB). All students will have the option to do all three rotations.
ii. Facilities

NASA/Johnson Space Center (JSC), Clear Lake, TX. KINE 685, NUEN 685, NUTR 685 (3 units). During the training program, students will have opportunities to work in individual laboratories located at JSC. These laboratories include Exercise Physiology, Nutritional Biochemistry, and Radiation Biodosimetry. The Johnson Space Center has a variety of formalized Education and Student Programs available to graduate students. If desired, trainees in the Ph.D. program could apply for positions in the Cooperative Education Program and the Graduate Student Researcher Program.

The University of Texas Medical Branch at Galveston (UTMB). KINE 685, NUEN 685, NUTR 685 (3 units). UTMB has a General Clinical Research Center that can house 12 volunteers, and includes full dietary and nursing support. Many bed-rest studies are conducted here, providing an excellent learning environment for graduate students who desire to learn how such studies are conducted. Equipment is available to perform sample isolation, processing, derivations, and analysis using techniques such as gas chromatography/mass spectrometry, isotope ratio mass spectrometry, and liquid chromatography mass spectrometry.

Brookhaven National Laboratory, Upton, NY. KINE 685, NUEN 685, NUTR 685 (3 units). Students will apply to participate in the Brookhaven National Laboratory rotation during their first year of the program. Up to fifteen students are accepted to participate in the NASA Space Radiation Summer School. Graduate students will gain training in the important areas of space radiation biology and protection and simulates space radiation. Students will have access to equipment necessary to monitor cellular and systemic responses to radiation. Course work covers the space radiation environment, charged particle physics, and radiobiology of high LET radiation, as well as other topics determined by the needs of the group in attendance. Laboratory exercises include physical measurement techniques (dosimetry), DNA damage and repair, in vitro cell response measurements, in vivo chromosome aberration and cell population quantification. Topics include photon and charged-particle irradiation techniques for biochemical samples, cultured cells, and laboratory animals.

D. Research Program

The major advisors of the graduate students are currently educating graduate students in topics related to space life science and have formed collaborative relationships across disciplines. For example, a number of faculty with primary appointments in Kinesiology are also on the Faculty of Nutrition, and a graduate student in Nuclear Engineering is being co-mentored by a faculty member in Nutrition. Faculty members of the Ph.D. program derive from three different colleges – Agriculture and Life Sciences, Education and Human Development, and Engineering. They are supported by NASA, NSBRI, NIH, USDA, and other nationally recognized funding agencies and foundations. Most of the research programs are interdisciplinary in nature, thereby creating synergistic research opportunities that overlap the boundaries of our three critical research areas.

E. Teaching/Service Training Program
Fellows will receive training in how to communicate information on space life sciences to others by participating in the Partnership for Environmental Education and Rural Health (PEER; http://peer.tamu.edu/) and the Science, Technology, Engineering and Mathematics program (STEM). These programs, funded by the National Science Foundation (NSF) and National Institute of Environmental Health Sciences (NIEHS), promote development of the next generation of scientists and workers in biomedical and health-related sciences. Students will be trained on how to make streaming videos on space life sciences for use in a K-12 classroom. In addition, they will learn from K-12 teachers on how to present materials on space life sciences in the classroom. Trainees will be encouraged to attend the Graduate Teaching Seminar Series offered by the Center for Teaching Excellence. The seminar series covers such topics as: Faculty Professional Development, mentor-Protégé Relationships, Effective Time Management, Writing Effective Research Grant Proposals, Developing a Teaching Portfolio, Peer Review of Teaching, Balancing personal and Professional Life.

Part IV: Model Plan for Ph.D. Students in Kinesiology, Nuclear Engineering, or Nutrition Seeking a Certificate in Space Life Sciences

A. Model Plan for Students Seeking a Ph.D. in Kinesiology and the Certificate in Space Life Sciences (Total number of required hours: 17):

**Year One**

Fall Semester
- KINE 646 Fundamentals of Space Life Sciences (submitted, please see Appendix D).

Spring Semester
- VMID 686 Scientific Ethics
- KINE 681 Seminar in Space Life Sciences

Summer Semester
- KINE 685 NASA/Johnson Space Center (JSC), Clear Lake, TX

**Year Two**

Fall Semester
- Students can select from the following courses: 1) Nutritional Biochemistry I (NUTR 641) and 2) Microdosimetry (NUEN 615).

Spring Semester
- Classes and workshops coordinated by the Center for Teaching Excellence.
- If desired, apply for a position in the NASA Space Radiation Summer School.
- Abstracts should be submitted for presentations at national meetings.

Summer Semester
- Students can select from the following Directed Studies summer training programs (KINE 685): 1) The University of Texas Medical Branch at Galveston (UTMB) and/or 2) Brookhaven National Laboratory, Upton, NY.

**Year Three**
Fall, Spring and Summer Semesters
- Students can select from the following courses: 1) Nutritional Biochemistry I (NUTR 641) and 2) Microdosimetry (NUEN 615).
- Students can select from the following Directed Studies summer training programs (KINE 685): 1) The University of Texas Medical Branch at Galveston (UTMB) and/or 2) Brookhaven National Laboratory, Upton, NY.

**Year Four**
Fall, Spring and Summer Semesters
- Continue research program. Presentations at national meetings are expected as are the first publications generated by the research program.

**Year Five**
Fall, Spring and Summer Semesters
- When needed, research should be nearing completions, manuscripts published and dissertations written and defended.

B. Model Plan for Students Seeking a Ph.D. in Nuclear Engineering and the Certificate in Space Life Sciences (Total number of required hours: 17):

**Year One**
Fall Semester
- NUEN 646 Fundamentals of Space Life Sciences (submitted, please see Appendix D).

Spring Semester
- VMID 686 Scientific Ethics
- NUEN 681 Seminar in Space Life Sciences

Summer Semester
- NUEN 685 NASA/Johnson Space Center (JSC), Clear Lake, TX

**Year Two**
Fall Semester
- Students can select from the following courses: 1) Nutritional Biochemistry I (NUTR 641) and 2) Applied Exercise Physiology (KINE 649).

Spring Semester
- Classes and workshops coordinated by the Center for Teaching Excellence.
- Apply for a position in the NASA Space Radiation Summer School.
- Abstracts should be submitted for presentations at national meetings.

Summer Semester
- Students can select from the following Directed Studies summer training programs (NUEN 685): 1) The University of Texas Medical Branch at Galveston (UTMB) and/or 2) Brookhaven National Laboratory, Upton, NY.
Year Three
Fall, Spring and Summer Semesters
- Students can select from the following courses: 1) Nutritional Biochemistry I (NUTR 641) and 2) Applied Exercise Physiology (KINE 649).
- Students can select from the following Directed Studies summer training programs (NUEN 685): 1) The University of Texas Medical Branch at Galveston (UTMB) and/or 2) Brookhaven National Laboratory, Upton, NY.
- Presentations at national meetings are expected by this year.

Year Four
Fall, Spring and Summer Semesters
- Continue research program. Presentations at national meetings are expected as are the first publications generated by the research program.

Year Five
Fall, Spring and Summer Semester
- When needed, research should be nearing completions, manuscripts published and dissertations written and defended.

C. Model Plan for Students Seeking a. Ph.D. in Nutrition and the Certificate in Space Life Sciences (Total number of required hours: 17)

Year One
Fall Semester
- NUTR 646 Fundamentals of Space Life Sciences (submitted, please see Appendix D).

Spring Semester
- VMID 686 Scientific Ethics
- NUTR 681 Seminar in Space Life Sciences

Summer Semester
- NUTR 685 NASA/Johnson Space Center (JSC), Clear Lake, TX

Year Two
Fall Semester
- Students can select from the following courses: 1) Applied Exercise Physiology (KINE 649) and 2) Microdosimetry (NUEN 615).

Spring Semester
- Participate in classes and workshops coordinated by the Center for Teaching Excellence.
- If desired, apply for a position in the NASA Space Radiation Summer School.
- Abstracts should be submitted for presentations at national meetings.

Summer Semester
- Students can select from the following Directed Studies summer training programs (NUTR 685): 1) The University of Texas Medical Branch at Galveston (UTMB) and/or 2) Brookhaven National Laboratory, Upton, NY.

**Year Three**
Fall, Spring and Summer Semesters
- Students can select from the following courses: 1) Applied Exercise Physiology (KINE 649) and 2) Microdosimetry (NUEN 615).
- Students can select from the following Directed Studies summer training programs (NUTR 685): 1) The University of Texas Medical Branch at Galveston (UTMB) and/or 2) Brookhaven National Laboratory, Upton, NY.
- Presentations at national meetings are expected by this year.

**Year Four**
Fall, Spring and Summer Semesters
- Continue research program. Presentations at national meetings are expected as are the first publications generated by the research program.

**Year Five**
Fall, Spring and Summer Semesters
- When needed, research should be nearing completions, manuscripts published and dissertations written and defended.

All students must complete preliminary examinations and have an approved dissertation proposal as part of the Ph.D. requirements.

The degree plan of the Ph.D. student is the responsibility of the student and the student’s graduate committee. The purpose of the core is only to provide a minimum number of courses in various disciplines to ensure that students receive a foundational education in Space Life Sciences.

If a student wishes to participate in all three experiential components (9 credit hours) the student will have a total of 20 credit hours to obtain the Certificate.

**PART V: Summary of the Steps Required to attain the Certificate.**

**Introduction**
All students applying for the Texas A&M University Ph.D. Training Program in Space Life Sciences must be accepted into one of the three doctoral programs in one of three disciplines, Kinesiology, Nuclear Engineering, or Nutrition.

**Step One: Submission of an Application to the Ph.D. Program in Space Life Sciences**
For consideration into the program, a student applicant must have a strong interest in space life sciences and submit the following documents that will be reviewed by the admissions committee: 1) an Application for the Ph.D. Training Program in Space Life Sciences (please see Appendix A), 2) Texas A&M University graduate application, 3) letters of recommendation, 4) university transcript, 5) letter of support for the applicant from the graduate student’s mentor, and 6) a written essay (2 to 3 pages) describing potential research and career goals, and how the Ph.D. program in Space Life Sciences will
help them achieve their goals. Students with the highest potential will be invited to campus to meet with teaching and research faculty and with student organizations as appropriate.

**Step Two: Review of the Application**

The admissions committee that consists of faculty from each of the three degree-granting entities, will review applications for the Ph.D. Program. The admissions committee will coordinate with the admissions committees for each of the respective degree-granting departments/faculties. Student selection will be based on the student's academic potential, training, interest, and commitment to entering the Texas A&M University Space Life Sciences Ph.D. Program.

**Step Three: Advisory Council review and Examination**

The Advisory Committee will review each student’s degree program and confirm they satisfy the requirements for the certificate program.

**Step Four: Issuance of the Certificate**

The Dean for the College of Agriculture and Life Sciences will sign the Certificate in Space Life Sciences. The certificate will be awarded after the student has completed the requirements for the certificate and the specific degree for which they are involved, Kinesiology, Nuclear Engineering or Nutrition. Once the student has completed these requirements, a Certificate in Space Life Sciences will be noted on the trainees’ official University transcript in addition to grades for the courses taken to fulfill the requirements of the certificate.

**PART VI: References**


PART VII: APPENDIX
Appendix A

Application for the Ph.D. Training Program in Space Life Sciences
Application for Ph.D. Training Program in Space Life Sciences

Name: ________________________________

UIN: ________________________________

Degree Sought: ________________________________

Major Professor: ________________________________

Years at TAMU: ________________________________

GPR: ___________ (undergrad) _________________ (graduate)

__________________________  __________________________
Student Signature          Date

__________________________  __________________________
Faculty Signature          Date

Deadline: Complete package must be submitted by June 8, 2007. Selections will be made by July 15 and student involvement will be activated with the Fall, 2007 semester.

Benefits of participation include a fellowship ($20,000/year for two years) and tuition payment (not including fees) for two years.
Application components include:
1. Application cover page.
2. Copy of TAMU graduate application, including letters of recommendation, etc. (unofficial transcripts are acceptable).
3. Curriculum vitae or resume of student
4. Letter of support for the application from the graduate student’s mentor.
5. Student essay (2 to 3 pages) describing potential research and career goals, emphasizing how participation in this program will help you to achieve your career goals.

Training program participants will pursue graduate degrees in either: 1) Nutrition, 2) Kinesiology, or 3) Nuclear Engineering.

Participation in the program requires completion of extra courses and experiential training events that will lead to a Certificate in Space Life Sciences that will appear on transcripts.
1. All students will take a new course on the “Fundamentals of Space Life Sciences”, a course on Scientific Ethics and participate in the Space Life Sciences Seminar.
2. Students will also be required to take two courses outside of their major; these include NUTR 641 (for NUEN and KINE); KINE 649 (for NUTR and NUEN); and NUEN 615 (for NUTR and KINE).
3. All students will participate in an experiential event at NASA/JSC during their first summer and during the second summer they will participate in either the Brookhaven National Laboratory summer school or in bed rest studies conducted at UTMB Galveston.
4. Lastly, all trainees will participate on two of the teaching/service components, which include giving lectures to middle/high school classes, preparing a streaming video to be used in other classroom settings, and participating in workshops/seminars held by the Center for Teaching Excellence.
Appendix B

Doctoral degree descriptions in Kinesiology, Nuclear Engineering and Nutrition
Ph.D. in Kinesiology

A Ph.D. in Kinesiology with a specialization in Exercise Physiology prepares students for teaching and research careers (http://hlknweb.tamu.edu/). Graduates are trained for postdoctoral appointments and permanent positions in universities, industry, or research institutes. The program prepares students to conduct research in basic and applied exercise physiology. Emphasis can be in applied programs of neuromuscular efficiency and control, exercise and lipid metabolism, and changes in bone structure and metabolism in response to exercise as well as disuse, bed rest or microgravity. Emphases in basic research include mechanisms of exercise-induced injury, neuromuscular efficiency, muscle blood flow, muscle metabolism, or free-radical stress, and the molecular biology of bone adaptation to stress.

Ph.D. in Nuclear Engineering (Health Physics)

The Ph.D. in Nuclear Engineering (Health Physics training) provides specialized training for students interested in radiation effects on matter, internal and external dosimetry and microdosimetry, radiation interactions and shielding, complexity of the space-radiation environment, sterilization and food processing, radiation biology/carcinogenesis, and medical diagnostic and therapeutic treatments. Areas of research available include solid/ion interactions, particle transport, space nuclear power systems, dosimetry, medical isotopes, and interactions with living tissue (http://nuclear.tamu.edu/home/).

Ph.D. in Nutrition

The Interdisciplinary Faculty of Nutrition grants Ph.D. degrees in Nutrition (http://nutr.tamu.edu/). The program is aimed at training independent researchers capable of working in academia, industry, or government on projects dealing with nutritional biochemistry and molecular biology, as well as clinical and community nutrition. Students are able to conduct research projects aimed at understanding the role of nutrients in carcinogenesis, immune function, cardiovascular health, diabetes, regulation of bone and muscle metabolism, and reproduction.
Appendix C

Syllabi for Mandatory Courses
Nutrition, Nuclear Engineering, Kinesiology 646  
(NUTR/NUEN/KINE 646)  
Fundamentals of Space Life Sciences  
Course Syllabus, Fall, 2007

**Instructor:** Nancy D. Turner, Ph.D.  212 Kleberg, 847-8714  
n-turner@tamu.edu

**Time/Location:**  9:30 – 10:45, Rm. 213 Kleberg

**Textbook:** All materials will be from original journal articles, supplemented with references to textbook as appropriate. All reading materials will be posted on the web and students are required to access these materials through the Texas A&M web based system.

**Course Description:** This course is designed to integrate nutrition, biochemistry, physiology and radiation biology to define the major biological problems encountered in long duration space flight. It will provide an overview of each of these problems with potential countermeasures against the problems. Countermeasure development will focus primarily on nutrition and exercise protocols to counter problems of bone loss, muscle wasting, and radiation-enhanced carcinogenesis. Experts in each of these areas will have a good understanding of the major biological problems facing long duration space flight, and their countermeasures.

**Prerequisites:** An undergraduate degree in Nutrition, Kinesiology or Health Physics or similar qualifications. Contact instructor for further guidance in this area.

**Course Objectives:** With successful completion of the course, you will have achieved:

1. An integrated understanding of the major life science problems encountered during long duration space flight.
2. An integrated understanding of the primary agencies involved in long duration space flight (NASA, NSBRI, ESA) and the types of research models used to assess the severity of physiological changes occurring during long duration space flight and the potential of countermeasures to ameliorate these problems.
3. An integrated understanding of countermeasures against the critical problems of long duration space flight and history of what has and has not worked to date.
**Evaluation:** Exams - 3 (100 points each)  
Oral presentation on a problem of long duration  
space flight and a proposed countermeasure (choose a  
topic outside of your own graduate  
degree program)  
Paper describing the topic of oral presentation  

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<td>Paper</td>
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**Grading Scale:**  
90-100%  A  70-79  C  
80-89  B  60-69  D  
59% and below  F

**Make-up Policy:** Make-up examinations will be given only for university authorized absences. It is the student's responsibility to arrange a date and time with the instructor. If possible, students should make arrangements prior to the scheduled examination time.

The oral presentation will be given during the last two weeks of regular classes. Papers will be due the week before finals. The papers need to be 10-12 double spaced pages (1 inch margins and 12 point font) and the information presented should be supported by results from original research articles (n > 15) and review articles (no more than 5).

**Americans with Disabilities Act (ADA) Policy Statement:** The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Room B118 of Cain Hall, call 845-1637 or visit: http://disability.tamu.edu.

**Academic Integrity Statement:** All syllabi shall contain a section that states the Aggie Honor Code and refers the student to the Honor Council Rules and Procedures on the web (http://www.tamu.edu/aggiehonors/index.html). All students should make themselves aware of correct citation techniques by reviewing the Academic Integrity Tutorials available on the library web site (http://library.tamu.edu/portal/site/Library).

**Aggie Honor Code:** “An Aggie does not lie, cheat, or steal or tolerate those who do.”
LECTURE SCHEDULE

8/27  Introduction to the course, content and methods of evaluation. The role of NASA and NSBRI in space life sciences. (Turner)

8/29  **Space physiology, overview.** The space environment and how it differs from earth. Major research methods and techniques to study space-related problems and their countermeasures. (Bloomfield)

9/3   Bone loss and risk of fracture and renal stones I (Bloomfield)
9/5   Bone loss and risk of fracture and renal stones II (Bloomfield)

9/10  Sleep disruptions, impact on performance (Dinges – video)
9/12  Skeletal muscle atrophy, changes in muscle function (Fluckey)

9/17  Altered muscle protein synthesis and degradation (Lawler)
9/19  Cardiovascular changes: orthostatic intolerance, distribution of blood flow and impact on aerobic work capacity (Woodman)

9/24  **Exam: Space physiology**

9/26  **Space Nutrition:** Space flight and ground based research in nutrition and review of space food, intake patterns (Turner)

10/1  Depressed food intake and its consequences (Lupton)
10/3  Protein and amino acid turnover - relationship to loss of muscle mass (Wu)

10/8  Lipid metabolism – role in signaling pathways (Chapkin)
10/10 Mineral requirements, balance studies and other measures of turnover, e.g. Calcium (Smith)

10/15 Antioxidants and other vitamin roles in space (Walzem/Turner)
10/17 Interaction of nutrition with radiation (Turner)

10/22 **Exam: Space Nutrition**

10/24  **Space Radiation:** Radiation and radiation production (Braby)

10/29  The space radiation environment, solar cycle and regions of space (Braby)
10/31  Radiation detection and measurement (Braby)

11/5  Physical countermeasures against radiation (Braby)
11/7   Radiation chemistry and DNA damage and repair (Ford)

11/12 Biological effects of high and low LET radiation, synergistic effects of microgravity/ altered gravity and radiation (Ford)
11/14 Biological effects of space radiation observed in astronauts, radiation protection and regulations for space flight (Ford)

21
11/19    Biomedical countermeasures to radiation exposure (Ford)
11/21    **EXAM: Space Radiation**
11/26    Student presentations
11/28    Student presentations

12/3     Redefined day – Friday classes (could use this time instead of 12/10)
12/5     Reading day, no classes
12/10    Student presentations, class evaluation
SYLLABUS
VMID 686
Scientific Ethics
Spring, 2006

Class Credit: 1 hour

Pre-requisite(s): Graduate student classification

Also, articles and/or supplementary reading and materials will be used.

Course Coordinator: Larry Johnson
Veterinary Integrative Biosciences
Faculties of Toxicology and Reproduction
845-9279; L.Johnson1@tamu.edu

Grade Composition: 50% Classroom participation in discussions
50% Term paper describing a research ethical issue and its possible resolution

Goals & Objectives: The course will be an overview of ethical issues encountered by toxicologists and other scientists in the conduct and dissemination of their research, in their pursuit of resources, in their interactions with the press and the broader public, and resulting from the extension and technological application of their findings. Students should develop vocabulary and thinking skills that will enhance their ability to make informed, ethical decisions and to communicate the rationale for their actions to other scientists and to the broader public.

Class meets on Thursdays at 3:30 pm for 1-2 hours depending upon daily presentations in the Veterinary Medical Administration Building, Room 107D. Student’s performance will be evaluated based on participation in discussions and a term paper describing a research ethical issue and its possible resolution. Students will be expected to complete “Human Participant Protections Education for Research Teams” online course sponsored by NIH (http://cme.cancer.gov/clinicaltrials/learning/humanparticipant-protections.asp) and provide written evidence of their certification before February 16.

Policies:
1. The University has established a formal process for handling of student grievances associated with any course. A "Classroom Communication Concerns" form is available from the Associate Dean’s Office that may be completed and submitted to the department head should there be major concerns about the conduct of the course.

2. The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. This legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please see me and contact Student Life, Services for Students with Disabilities [Room 126, Koldus Bldg. (5-1637)].
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Instructor of Record: Larry Johnson, PhD, Professor, Veterinary Integrative Biosciences (845-9279)
Meets Thursday, 3:30 pm, in VMA 107-D
May 4 1 Discussion of Term Papers Larry Johnson
VIBS
DEPARTMENT OF HEALTH & KINESIOLOGY
TEXAS A&M UNIVERSITY

KINE 681, Section 610: Space and Life Sciences Seminar
Spring, 2007 -- Time TBD
Location: TBD (50 minutes, once per week)

Course Coordinator: Dr. Sue Bloomfield, Professor
207B Old Heep Hall, Lamar & Spence
862-1181, sbloom@tamu.edu
Office hours: by appointment

Purpose:
1) To gain exposure to current research and prominent investigators in space life sciences topic areas;
2) To develop skill in presenting current research published in top journals in nutrition, physiology and radiation biology;
3) To stimulate critical analysis and active questioning of oral presentations of data;
4) To foster interaction among current graduate students and faculty interested in space life sciences.

Methods:
1) Regular attendance at scheduled seminars
2) Careful review of articles provided in advance of each presentation, and active participation in discussions
3) Short written summaries of visiting speakers’ presentations

Evaluation: Attendance is mandatory and will be verified with a sign-in sheet. Make sure you find and sign the attendance sheet, or you will be counted absent. Each student is allowed one unexcused absence for the semester. If you have a valid excuse (illness or family emergency), contact the instructor by email or phone before class (preferably) or by noon of the next day to assure an accurate record of your attendance. Final grades will be based on active participation in seminar discussions (30%), written summaries (40%) and journal article presentations (30%).

Required readings: Copies of at least one article relevant to each research presentation will be supplied to you by email; be sure that the email address you supply the instructor is one you check daily. You are responsible for downloading and reading these articles in time to prepare for each session.

FOR ANY STUDENTS WITH DISABILITIES
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a
disability requiring an accommodation, please contact the Office of Support Services for Students with Disabilities in Room 126 of the Koldus Building. The phone number is 845-1637.
KINE 649 -APPLIED EXERCISE PHYSIOLOGY
Fall 2007

Instructor: Dr. Steven Riechman
Office: 449 Read/GRW
Phone: 862-3213
Email: sriechman@hlkn.tamu.edu
Web: sriechman.tamu.edu
Office Hours: MWF; 11:00-123:00 or by appointment (preferred)

Prerequisites: KINE 433 or equivalent

Required Readings: Current reviews and research papers will be assigned for each topic.

Course Objectives:

1. To understand how environmental factors (temperature, altitude, microgravity), development, aging, and gender alter the physiological responses to acute exercise and chronic physiological adaptations to exercise training.
2. To understand the mechanisms responsible for the physiological responses and adaptations that occur in response to varying environmental conditions.
3. To understand the mechanisms by which development, age, and gender influence physiological responses and adaptations to exercise and exercise training.
4. To gain a basic understanding of the pathophysiology of cardiovascular, metabolic, and bone diseases and the physiological role of exercise in prevention and/or treatment of these diseases.
5. To enable the student to read and evaluate the scientific literature that encompasses the topics of discussion included in these areas.
6. To improve written and oral communication skills through presentation of scientific articles and written review of the scientific literature.

Exams and Grading:

1. Examination 1: 20%
2. Examination 2: 15%
3. Examination 3: 20%
4. Written Review: 20%
5. Article Presentations: 20%
6. Class Participation: 5%

Grades:

A (90%)
B (80%)
C (70%)
D (60%)
F <60%)

28
Assignments:

Each student will be asked to present two research articles during course sessions. These oral presentations will summarize and integrate findings from an original research article or a relevant review paper into the topic presented. The presentations will be scheduled for 30 minute sessions. Assignment of presentations will occur such that each student will present twice, in different sections of the course (See course outline). Students will select the topics that they will present. The article for each topic will be selected through search of databases by students to identify important recent findings or seminal papers that have been essential to our understanding of the topic. A good way to find these articles is a forward search of review articles. This can be done at [http://portal.isiknowledge.com/](http://portal.isiknowledge.com/), Web of Science, Cited Ref search. Instructor will approve all articles.

Students will select one of their presentation topics for their term papers. 10 page double spaced pages to review the landmark studies and summarize our current understanding of the topic. Also, these papers, to varying degrees depending on topic, will describe the current practical (Applied) recommendations, summarize new research (within past year) and clearly define the unanswered questions.

Attendance:

Attendance requirements will be as described in the Texas A&M University Student Rules handbook. TAMU views attendance as an individual student's responsibility; however, a small portion of your grade is based on class participation. Without attending class, it is unlikely that any credit can be awarded for class participation. Students are required to attend class for scheduled examinations. Only excused absences, as defined by the Texas A&M University Student Rules handbook will be accepted for absence from a scheduled exam period. The time frame outlined in the handbook for contact of the instructor regarding excused absences will be observed; however, prompt notification is strongly encouraged. Exams will not be administered early.

Suggestions for Class Preparation:

1. Participation and a better understanding of the material presented in class will be facilitated by reading in preparation for each class period.

2. Participation grade will be based on the student's preparation for class presentations and on the student's participation in classroom discussion. All articles being presented should be read by all students before coming to class.

3. Tests will be administered during scheduled class periods. Success on exams will be best facilitated by keeping current in the class and periodic review of class material. If questions arise or clarification is needed, these should be brought to my attention either in class or during a scheduled office appointment. Be certain to allow ample time for these considerations before the scheduled exam.

Americans with Disabilities Act (ADA):

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for
reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Cain Hall. The phone number is 845-1637.

Plagiarism:

The handouts used in this course are copyrighted. By "handouts," I mean all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, lab problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless I expressly grant permission.

As commonly defined, plagiarism consists of passing off as one's own the ideas, words, writings, etc., which belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you should have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated.

If you have any questions regarding plagiarism, please consult the latest issue of the Texas A&M University Student Rules, under the section "Scholastic Dishonesty."

Academic Integrity:

"Aggies do not lie, cheat or steal, nor do they tolerate those who do."

"The Aggie Code of Honor is an effort to unify the aims of all Texas A&M men and women toward a high code of ethics and personal dignity. For most, living under this code will be no problem, as it asks nothing of a person that is beyond reason. It only calls for honesty, integrity, characteristics that Aggies have always exemplified. The Aggie Code of Honor functions as a symbol to all Aggies, promoting the understanding and loyalty to truth and confidence in each other."

All students are expected to abide by the Aggie Honor Code. Students should be aware of all Honor Council Rules and Procedures on the Honor Council website at www.tamu.edu/aggiehonor.
Applied Exercise Physiology Course Outline

Section 1: Environmental Conditions

I. Introduction
A. Conditions that affect the stress of a single bout of exercise
   i. Rate of work
   ii. Mode of activity
   iii. Duration of activity
   iv. Environmental factors
      1. heat, cold, humidity, wind
      2. altitude
      3. pressure
B. Acclimatization and/or acclimation to environment during chronic training
   i. Basic adaptations to training stimulus
   ii. Additional adaptations to environmental factors

II. Environmental Temperature, Body Temperature, and Thermoregulation
A. Basics of Thermoregulation
   i. Core temperature
   ii. Skin temperature
   iii. Mean body temperature
   iv. Set point
   v. Sensible heat loss
   vi. Insensible heat loss
B. Heat Balance Equation
C. Pathways of Heat Exchange
   i. Sensible or dry heat exchange
      1. Convection
      2. Conduction
      3. Radiation
   ii. Insensible or evaporative heat exchange
   iii. Heat storage
D. Thermoregulation During Acute Exercise in the Heat
   i. Core Temperature Response to Exercise
   ii. Metabolism
   iii. Evaporative Heat Loss
   iv. Skin Circulation and Heat Transfer
   v. Cardiovascular Consequences of Thermoregulatory Increases in Skin Blood Flow
E. Alterations in Thermoregulation with Heat Acclimatization and Exercise Training
   i. Conditions Necessary to Produce Heat Acclimatization
   ii. Relation of Acclimatization to Physical Fitness and Aerobic Training
   iii. Changes in Thermoregulatory Responses
      a. Sweating.
      b. Skin Circulation
      c. Thermoregulatory Set Point
   iv. Changes in Non-thermoregulatory Responses
      a. Circulatory Changes
b. Endocrine and Metabolic Changes

F. Thermoregulation During Rest and Exercise in the Cold
   i. Modes of Cold Stress
   ii. Sources of Heat Gain and Loss
       a. Nonshivering Thermogenesis
       b. Shivering Thermogenesis
       c. Exercise Metabolism
   iii. Blood Flow and Distribution
   iv. Body Fat
   v. Acclimatization to Cold
       a. Metabolic Adaptations
       b. Cardiorespiratory Adaptations
       c. Insulative Adaptations

III. Altitude
A. Physiological Challenge of High Altitude
   i. Reduced Barometric Pressure
   ii. Oxygen Saturation of Blood
   iii. Partial Pressure Gradient Drop
B. Effects of Altitude on Performance
C. Acute Physiological Responses to Altitude
   i. Ventilation and Heart Rate
   ii. Plasma Volume
   iii. Heart Rate
   iv. Acute Altitude Sickness
D. Acclimatization to High Altitude
   i. Pulmonary Gas Exchange
   ii. Physical Work Capacity
   iii. Oxygen Transport and Delivery
   iv. Body Composition and Metabolism
   v. Neurohumoral Responses
   vi. Mitochondria and Oxidative Enzymes
E. Training at Altitude

IV. Microgravity
A. Acute Response to Environmental Stress of Microgravity
   i. Acute Effects on Fluid and Pressure Distribution
   ii. Acute Neurohumoral Responses
B. Models for Simulating Microgravity
   i. Immobilization: Casting and Suspension
   ii. Bed Rest and Head-down Tilt
   iii. Immersion and Neutral Buoyancy
   iv. Parabolic Flight
C. Physiological Adaptations to Chronic Exposure to Microgravity
   i. Muscle
   ii. Bone
   iii. Cardiovascular
   iv. Body Composition and Metabolic Rate
v. Fluid and Electrolyte Balance
vi. Immune Function

D. Exercise as a Countermeasure
   i. Aerobic Training
   ii. Anaerobic Training
   iii. Resistance Training

Section 2: Development, Aging, and Gender

I. Children and Adolescents
   A. Growth and Development of Body Tissues
      i. Height and Weight
      ii. Bone
      iii. Muscle
      iv. Fat
   B. Physiological Responses to Acute Exercise
      i. Neuromuscular
      ii. Metabolic
      iii. Cardiovascular
      iv. Pulmonary
   C. Physiological Adaptations to Exercise Training
      i. Aerobic Training
      ii. Anaerobic Training
      iii. Resistance Training

II. Gender Effects
   A. Gender Differences in Body Composition
      i. Bone
      ii. Muscle
      iii. Fat
   B. Gender Differences in Physiological Responses to Acute Exercise
      i. Neuromuscular
      ii. Metabolic
      iii. Cardiovascular
   C. Exercise Training Responses in Males and Females
   D. Female Athlete Triad

III. Aging
   A. Age-related Physiological Adaptations
      i. Cardiovascular
      ii. Body Composition
      iii. Muscular Strength
      iv. Bone
      v. Neural
      vi. Respiratory
   B. Physiological Responses to Acute Exercise with Aging
      i. Neuromuscular
      ii. Metabolic: aerobic and anaerobic
iii. Respiratory
iv. Cardiovascular

C. Physiological Adaptations to Exercise Training
   i. Anaerobic Training
   ii. Aerobic Training
   iii. Resistance Training

Section 3: Disease States and Effects of Exercise Training

I. Cardiovascular Disease
A. Forms and Pathophysiology of Cardiovascular Disease
   i. Hypertension
   ii. Coronary Artery Disease
   iii. Stroke
   iv. Congestive Heart Failure

B. Risk Factors for Cardiovascular Disease
   i. Hypertension (as a risk factor)
   ii. Blood Lipids
   iii. Smoking
   iv. Physical Inactivity
   v. Obesity
   vi. Diabetes

C. Exercise in Prevention and Treatment of Cardiovascular Disease
   i. Adaptations of the Heart and Vasculature to Exercise Training
   ii. Alterations in Risk Factors with Exercise Training

II. Obesity and Maintenance of Body Weight
A. Definitions
   i. Overweight
   ii. Obesity
   iii. Underweight
   iv. Anorexia
   v. Bulimia

B. Prevalence
C. Body Composition Assessment
D. Determination of Energy Intake and Expenditure
E. Relationship Between Body Composition and Disease States
   i. Atherosclerosis
   ii. Hypertension
   iii. Diabetes
   iv. Cancer

F. Role of Physical Activity in Control of Body Weight and Treatment of Obesity
   i. Activity Patterns in Normal Weight and Obese Individuals
   ii. Changes in Body Composition Related to Physical Activity
   iii. Exercise Training vs. Caloric Restriction in Treatment of Obesity
   iv. Exercise Training: Effects on Resting Metabolic Rate
   v. Exercise Training: Effects on Energy Expenditure
III. Diabetes
A. Forms of Diabetes
B. Prevalence
C. Role of Exercise Training in Control of Blood Glucose
D. Role of Exercise Training in Reducing Risk Factors for Cardiovascular Disease Associated with Diabetes
E. Proposed Mechanisms for Beneficial Effects of Exercise Training in Type II Diabetes

IV. Osteoporosis
A. Type I and Type II Osteoporosis
   i. Osteopenia
   ii. Osteoporosis
   iii. Severe Osteoporosis
B. Prevalence
C. Basic Bone Physiology
D. Bone Mineral Density Assessment
E. Age-Related Changes in Bone Mineral Density
F. Risk Factors
G. Role of Exercise and/or Inactivity in Prevention and Treatment of Osteoporosis
   i. Inactivity: Effects of Bed rest and Microgravity
   ii. Exercise Training
      1. Aerobic Training
      2. Anaerobic Training
      3. Resistance Training
Kine 649 - Applied Exercise Physiology Class Schedule:

Class Schedule (Tentative)

Session 1: Introduction
Session 2: Thermoregulation
Session 3/4/5: Exercise and Exercise Training Responses in the Heat and Cold
Session 6/7: Exercise and Exercise Training Responses at Altitude
Session 8/9/10/11: Effects of Microgravity on Acute Responses to Exercise and Exercise Training
Session 12: Section 1 exam
Session 13-14: Exercise and Exercise Training in Children and Adolescents
Session 15-16: Gender Effects on Acute Responses to Exercise and Exercise Training
Session 17-18: Exercise and Aging
Session 19: Section 2 Exam
Session 20: Introduction to Disease
Session 21/22: Exercise and Treatment of Cardiovascular Disease
Session 23/24: Treatment of Obesity with Nutrition and Exercise
Session 25/26: Exercise and Diabetes
Session 27: Exercise and Osteoporosis
Session 28: Papers due, catch up/review
Session 29: Section 3 Exam

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Objective: The objective of this class is to acquire a working understanding of the physical and stochastic nature of radiation exposure at low doses, an appreciation for the significance of these properties as they influence the response of physical and biological systems to low dose and dose rate exposures, and an understanding of the methods used for evaluating energy deposition at low doses. The approach is through the stochastic nature of energy deposition in subcellular volumes, and is independent of dosimetric approaches developed for high level exposures. We will cover the processes involved in energy deposition, the definitions of microdosimetric quantities, mathematical simulation, measurement methods and instrumentation, data analysis, and applications including radiation protection and risk estimation.

Course Outline by Major Topics and time Assigned to Each:  

<table>
<thead>
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<th>Topic</th>
<th>Hours</th>
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<tr>
<td>Track structure characteristics of radiation</td>
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<td>Stochastic nature of interactions at atomic and molecular level</td>
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<td>Directly and indirectly ionizing radiation</td>
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<td>Ionization and excitation</td>
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<td>Delta rays</td>
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<td>Energy deposited by radiation</td>
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<td>Molecular changes</td>
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<td>Options for summarizing characteristics of an irradiation</td>
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<td>Distributions of multiply damaged sites</td>
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<td>Distributions of energy in fixed size site</td>
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<tr>
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<td>Basic quantities, ε, y, z</td>
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<td>Frequency distributions, f(y), f(z)</td>
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<td>Averages, frequency mean, dose mean</td>
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<tr>
<td>Dose distributions, d(y), d(z)</td>
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<tr>
<td>Characteristics of different radiations</td>
<td>3</td>
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<tr>
<td>Conventions for data presentation, yf(y)</td>
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</table>
Characteristics of x and gamma rays
Characteristics of neutrons
Characteristics of high energy heavy particles

Calculation of \( f(\varepsilon) \)
Approximation based on \( dE/dx \) and \( l \)
Errors due to straggling
Errors due to short tracks
Errors due to delta ray escape

Monte Carlo calculations
Full track simulation
Cross sections
Condensed track simulation

Measurement of \( f(\varepsilon) \)
Simulation of small sites
Proportional counter characteristics
Walled and wall-less sites
Artifacts created by walls
Detector design
Electronic requirements

Measurements of unknown radiation fields
Evaluating dose
Evaluating dose equivalent

Relationship to traditional dosimetry
Relationship of \( D \) to \( z \)
Relationship of \( L \) to \( y \)

Text: Microdosimetry and Its Applications, H. H. Rossi and M Zaider

Approach: There will be a limited number of homework problems which are intended to lead you through specific applications of the material that we cover. There will be two tests through the semester, plus the final examination. These tests will present measurement and data analysis problems which will require creative application of the concepts and definitions that we have discussed. Test questions may require "back of the envelope" calculations, but we are far more interested in your approach to the problem than in the precision of the numerical solution.

Grading: Homework 30%, tests 40%, final 30%.

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation
requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Room 126 of the Koldus Building, or call 845-1637.

Copyrights

The handouts used in this course are copyrighted. By "handouts" we mean all materials generated for this class, which include but are not limited to syllabi, lab problems, in-class materials, review sheets, and additional problem sets. Because these materials are copyrighted, you do not have the right to copy the handouts, unless the author expressly grants permission.

Scholastic Dishonesty

As commonly defined, plagiarism consists of passing off as one's own the ideas, work, writings, etc., that belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated. If you have questions regarding plagiarism, please consult the latest issue of the Texas A&M University Student Rules [http://student-rules.tamu.edu/], under the section "Scholastic Dishonesty."
NUTR 641: Nutritional Biochemistry
Fall 2007
TR 9:35 am - 10:50 am; Room 200, Kleberg Center

Instructor: Dr. Guoyao Wu (Tel. 845-1817; Office, 212 Kleberg Bldg.; e-mail: g-wu@tamu.edu)

Grading: Mid-Term Exams 30% (2x15%)
Final Exam (50%)
Term-paper (20%)

Mid-term and final exams are all open-book tests. This course requires the submission of a term paper, which may be written in one of the following formats:
1) A review article summarizing recent advances in any aspect of intermediary metabolism or metabolic regulation in animals/humans; and
2) A proposal of novel hypotheses on any aspect of nutritional biochemistry in animals/humans. A hypothesis should be formulated on the basis of published research.

All term-papers should discuss the physiological or nutritional significance of the chosen topic. Term-papers should be no more than 15 pages (not including references) in double-spaced typing, with a maximum of 40 references. Please follow the style of The Journal of Nutrition for preparing term papers. Term-papers are due at the time of the final exam.

Objectives of the Course: To help students integrate metabolic pathways with nutrition, physiology and disease of animals. To assist students in developing the ability of critically evaluating the scientific literature on metabolism of nutrients and its regulation in animals.

Description of the Course: Mechanisms of intestinal absorption of nutrients. Integration of the intermediary metabolism of glucose, amino acids, and lipids with nutrition, physiology, and pathophysiology in animals. Regulation of metabolic pathways in cells, tissues, and the whole body under normal, disease and special (e.g., weightlessness) conditions. Functions of vitamins and minerals in nutrient metabolism and health.

Prerequisites: NUTR 470, ANSC 601, BICH 602, BICH 411, BICH 412 or equivalent.


The following texts are recommended for basic knowledge of the subject:


Course Syllabus of NUTR 641: Nutritional Biochemistry

1. Introduction (1.5 hr)
   a. Course objectives, outline, and grading system
   b. The concept of nutritional biochemistry
   c. An overview of the animal system
   d. An overview of metabolic pathways

2. Basic concepts in metabolism (3 h)
   a. Reversible and irreversible reactions
   b. Equilibrium constant ($K_{eq}$)
   c. Free energy in chemical reactions
   d. Thermodynamics laws as applied to animal metabolism
   e. Cellular energy status and redox state
   f. Intracellular compartmentation of a metabolic pathway
   g. Substrate channeling (metabolon)
   h. Enzymes as biological catalysts
   i. Cell or tissue-specific metabolic pathways
   j. Physiological homeostasis
   k. Species differences in metabolism

3. The cytosolic glycolysis and its nutritional significance (3 hr)
   a. The pathway of glycolysis
   b. Physiological significance of glycolysis (skeletal muscle, red blood cells, rapidly proliferating cells, cultured cells)
   c. The Pasteur effect in animal cells
   d. Glycolysis and cell proliferation
   e. Energetics of glycolysis
   f. Regulation of glycolysis
   g. Quantification of glycolysis in animal cells
   h. Cytosolic redox state and transfer of NADH to mitochondrion.
   i. The Cori cycle
   j. The physiological significance of glucose metabolism

4. The mitochondrial citric acid cycle and the oxidation of acetyl-CoA (3 hr)
   a. The reactions of the Krebs cycle
   b. The amphibolic role of the Krebs cycle
   c. Isotopic exchanges in the Krebs cycle
   d. Oxidation of NAD(P)H and FADH$_2$ and ATP production via the respiratory chain
   e. Energetics of acetyl-CoA oxidation
   f. Mitochondrial redox state
   g. Regulation of oxidation of acetyl-CoA
   h. The Crabtree effect in animal cells
   i. The physiological significance of the Krebs cycle
5. The pentose phosphate pathway and its physiological significance (1.5 hr)
   a. The pentose phosphate pathway and generation of NADPH and ribose phosphate
   b. Physiological significance of the pentose phosphate pathway (liver, adipose tissue, phagocytes, red blood cells)
   c. Quantification of the pentose phosphate pathway
   d. The physiological functions of the pentose cycle

6. Gluconeogenesis and its physiological significance (3 hr)
   a. Importance of glucose as a fuel for red blood cells and the brain
   b. The pathway of gluconeogenesis in the liver and the kidney
   c. Provision of substrates for gluconeogenesis during inadequate food intake and infection
   d. Physiological significance of gluconeogenesis
   e. Hormonal regulation of gluconeogenesis
   f. Diabetes and gluconeogenesis
   g. Hepatic heterogeneity in gluconeogenesis
   h. The physiological significance of gluconeogenesis
   i. Diabetes and food deprivation

7. Metabolism of glycogen and its physiological significance (1.5 hr)
   a. Glycogen stores in the liver and skeletal muscle
   b. The pathway of glycogen synthesis (glycogenesis)
   c. The pathway of glycogen degradation (glycogenolysis)
   d. Mobilization of glycogen during fasting, exercise, and extra-vehicular activity
   e. Regulation of glycogen metabolism
   f. The physiological significance of glycogen metabolism

8. Fatty acid synthesis and oxidation (3 hr)
   a. Fat as an efficient energy store in animals
   b. The pathway of fatty acid synthesis
   c. The pathways of fatty acid oxidation
   d. Ketosis during fasting, lactation and pregnancy
   e. Physiological significance of ketone bodies
   f. Regulation of fatty acid synthesis and oxidation
   g. Energetics of fatty acid oxidation
   h. Insulin-dependent diabetes mellitus and hepatic ketogenesis
   i. Hepatic heterogeneity in fatty acid oxidation and ketogenesis
   j. The physiological significance of fatty acid metabolism
   k. Hyperlipidemia

9. Amino acid metabolism and ammonia detoxification (4.5 hr)
   a. The concepts of essential and nonessential amino acids in animal nutrition
b. Alanine and glutamine as the major vehicles of interorgan carbon and nitrogen transport in animals
c. The intestinal-renal axis of endogenous synthesis of arginine in mammals
d. Nitric oxide: biochemical synthesis and physiological significance
e. Glutaminolysis in animal cells and physiological significance
f. The urea cycle: compartmentation and regulation in the mammalian liver
g. Urea cycle reactions in extrahepatic tissues and physiological significance
h. Uric acid synthesis in the avian liver
i. Energetics of the synthesis of urea and uric acid
j. Disorders of the urea cycle in mammals
k. Hepatic heterogeneity in amino acid metabolism
l. The physiological significance of amino acid metabolism
m. Net protein balance of astronauts in space flight
n. Hyperammonemia
o. Orotic aciduria
p. Hyperhomocysteinemia

10. Nitrogen and carbon balance in animals (1.5 hr)

a. Nitrogen balance study in animals: values and limitations
b. Respiratory quotient in animals: values and limitations
c. Tracing of nitrogen and carbon in animals

11. pH and the regulation of acid-base balance in animals (3 hr)

a. The concept of pH
b. Generation of H⁺ in the body
c. The Henderson-Hasselbalch equation
d. The HCO₃⁻/CO₂ buffer system in the body
e. Renal ammoniagenesis and generation of HCO₃⁻ from glutamine
f. Importance of pH homeostasis in the body

12. Fuel utilization by animals (1.5 hr)

a. Major fuel stores in animals
b. The roles of gastrointestinal tract and other organs
c. Conversion of food energy to metabolic energy in animals
d. Energetic efficiency of metabolic transformations in animals
e. The physiological significance of fuel homeostasis

13. Metabolic coordination in animals (2 hr)

a. Glucose homeostasis
b. pH homeostasis
c. Ammonia detoxification
d. Immune system homeostasis
e. Tissue maintenance and growth
f. Fetal growth and development
g. Insulin resistance, obesity, and diabetes

14. Functions of vitamins in nutrient metabolism and antioxidant reactions (6 hr)
   a. Folate
   b. Vitamin B12
   c. Vitamin K
   d. Biotin
   e. Vitamin B6
   f. Vitamin A
   g. Vitamin D
   h. Niacin
   i. Thiamin
   j. Riboflavin
   k. Pantothenic acid
   l. Ascorbic acid (Vitamin C)
   m. Vitamin E

15. Functions of minerals in nutrient metabolism and antioxidant reactions (6 hr)
   a. Sodium, Potassium, Chloride
   b. Iodine
   c. Iron
   d. Calcium and Phosphate
   e. Magnesium
   f. Manganese
   g. Zinc and Copper
   h. Molybdenum, Sulfite, and Sulfate
   i. Selenium
   j. Other inorganic nutrients

16. Functions of other organic nutrients in metabolism and antioxidant reactions (1 hr)
   a. Choline
   b. Carnitine
   c. Inositol
   d. Other organic nutrients
Appendix D

New Course Request Forms
Texas A&M University
Departmental Request for a New Course
Undergraduate • Graduate • Professional

Submit original form and 2 copies. Attach a course syllabus to each.

1. This request is submitted by the Department of Nutrition and Food Science

2. Course prefix, number and complete title NUTR 646
   Fundamentals of Space Life Sciences

3. Course description (not more than 50 words) Integrate nutrition, physiology, and radiation biology to define major biological problems in long duration space flight; provide an overview of the problems of bone loss, muscle wasting, and radiation-enhanced carcinogenesis along with potential countermeasures; focus on nutritional interventions and exercise protocols.

4. Prerequisite(s) Cross-listed with NUEN 646 & KINE 646
   None
   Cross-listed courses require the signatures of both department heads.

5. Is this a variable credit course? □ Yes □ No
   If yes, from ________ to ________.

6. Is this a repeatable course? □ Yes □ No
   If yes, this course may be taken ________ times. Will the course be repeated within the same semester/term? □ Yes □ No

7. Has this course been taught as a 489/689? □ Yes □ No
   If yes, how many times? ______
   Indicate the number of students enrolled for each academic period it was taught. 5

8. This course will be:
   a. required for students enrolled in the following degree program(s) (e.g., B.A. in history)

   Texas A&M University Ph.D. Training Program in Space Life Sciences

   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography)

   An elective for M.S./Ph.D. students in Nutrition, Kinesiology, and Nuclear Engineering (Health Physics)

9. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

10. Prefix | Course # | Title (exclude punctuation)
      NUTR 646 | FUND SPACE LIFE SCIENCES

<table>
<thead>
<tr>
<th>Lect.</th>
<th>Lab</th>
<th>SCH</th>
<th>Subject Matter Content Code</th>
<th>Admin. Unit</th>
<th>Acad. Year</th>
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Do not complete shaded area.

Approval recommended by:

Head of Department: Michael M. McMurrey, Nov 9, 2007

Chair, College Review Committee:

Dean of College:

Submitted to Coordinating Board by:

Director of Academic Support Services:

To have this form reviewed, please send to Linda F. Lacey, Mail Stop 1265 or fax to 847-8737.

OAR/AS-504
Nutrition 646 (NUTR 646)
Fundamentals of Space Life Sciences
Course Syllabus, Fall, 2007
(Cross-listed with NUEN 646 & KINE 646)

Instructor: Nancy D. Turner, Ph.D. 212 Kleberg, 847-8714
n turner@tamu.edu

Time/Location: 9:30 – 10:45, Rm. 213 Kleberg

Textbook: All materials will be from original journal articles,
supplemented with references to text books as appropriate.
All reading materials will be posted on the web and
students are required to access these materials through the
Texas A&M web based system.

Course Description: This course is designed to integrate nutrition, biochemistry,
physiology and radiation biology to define the major
biological problems encountered in long duration space
flight. It will provide an overview of each of these
problems with potential countermeasures against the
problems. Countermeasure development will focus
primarily on nutrition and exercise protocols to counter
problems of bone loss, muscle wasting, and radiation-
enhanced carcinogenesis. Experts in each of these areas
will have a good understanding of the major biological
problems facing long duration space flight, and their
countermeasures.

Prerequisites: An undergraduate degree in Nutrition, Kinesiology or
Health Physics or similar qualifications. Contact instructor
for further guidance in this area.

Course Objectives: With successful completion of the course, you will have
achieved:
1. An integrated understanding of the major life science problems encountered during
long duration space flight.
2. An integrated understanding of the primary agencies involved in long duration space
flight (NASA, NSBRI, ESA) and the types of research models used to assess the severity
of physiological changes occurring during long duration space flight and the potential of
countermeasures to ameliorate these problems.
3. An integrated understanding of countermeasures against the critical problems of long
duration space flight and history of what has and has not worked to date.
Evaluation: Exams - 3 (100 points each) 
Oral presentation on a problem of long duration space flight and a proposed countermeasure (choose a topic outside of your own graduate degree program) 150 points 
Paper describing the topic of oral presentation 150 points 
TOTAL 600 points

Grading Scale: 90-100% A 70-79 C 
80-89 B 60-69 D 
59% and below F

Make-up Policy: Make-up examinations will be given only for university authorized absences. It is the student's responsibility to arrange a date and time with the instructor. If possible, students should make arrangements prior to the scheduled examination time.

The oral presentation will be given during the last two weeks of regular classes. Papers will be due the week before finals. The papers need to be 10-12 double spaced pages (1 inch margins and 12 point font) and the information presented should be supported by results from original research articles (n > 15) and review articles (no more than 5).

Americans with Disabilities Act (ADA) Policy Statement: The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Room B118 of Cain Hall, call 845-1637 or visit: http://disability.tamu.edu.

Academic Integrity Statement: All syllabi shall contain a section that states the Aggie Honor Code and refers the student to the Honor Council Rules and Procedures on the web (http://www.tamu.edu/aggiehonor/index.html). All students should make themselves aware of correct citation techniques by reviewing the Academic Integrity Tutorials available on the library web site (http://library.tamu.edu/portal/site/Library).

Aggie Honor Code: “An Aggie does not lie, cheat, or steal or tolerate those who do.”
### LECTURE SCHEDULE

**8/27**
Introduction to the course, content and methods of evaluation. The role of NASA and NSBRI in space life sciences. (Turner)

**8/29**
**Space physiology, overview.** The space environment and how it differs from earth. Major research methods and techniques to study space-related problems and their countermeasures. (Bloomfield)

**9/3**
Bone loss and risk of fracture and renal stones I (Bloomfield)

**9/5**
Bone loss and risk of fracture and renal stones II (Bloomfield)

**9/10**
Sleep disruptions, impact on performance (Dinges – video)

**9/12**
Skeletal muscle atrophy, changes in muscle function (Fluckey)

**9/17**
Altered muscle protein synthesis and degradation (Lawler)

**9/19**
Cardiovascular changes: orthostatic intolerance, distribution of blood flow and impact on aerobic work capacity (Woodman)

**9/24**
Exam: **Space physiology**

**9/26**
**Space Nutrition:** Space flight and ground based research in nutrition and review of space food, intake patterns (Turner)

**10/1**
Depressed food intake and its consequences (Lupton)

**10/3**
Protein and amino acid turnover - relationship to loss of muscle mass (Wu)

**10/8**
Lipid metabolism – role in signaling pathways (Chapkin)

**10/10**
Mineral requirements, balance studies and other measures of turnover, e.g. Calcium (Smith)

**10/15**
Antioxidants and other vitamin roles in space (Walzem/Turner)

**10/17**
Interaction of nutrition with radiation (Turner)

**10/22**
Exam: **Space Nutrition**

**10/24**
**Space Radiation:** Radiation and radiation production (Braby)

**10/29**
The space radiation environment, solar cycle and regions of space (Braby)

**10/31**
Radiation detection and measurement (Braby)

**11/5**
Physical countermeasures against radiation (Braby)

**11/7**
Radiation chemistry and DNA damage and repair (Ford)

**11/12**
Biological effects of high and low LET radiation, synergistic effects of microgravity/altered gravity and radiation (Ford)

**11/14**
Biological effects of space radiation observed in astronauts, radiation protection and regulations for space flight (Ford)
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Texas A&M University
Departmental Request for a New Course
Undergraduate • Graduate • Professional

Submit original form and 2 copies. Attach a course syllabus to each.

1. This request is submitted by the Department of Health and Kinesiology

2. Course prefix, number and complete title KINE 646
   Fundamentals of Space Life Sciences

3. Course description (not more than 50 words) Integrate nutrition, physiology, and radiation biology to define major biological problems in long duration space flight; provide an overview of the problems of bone loss, muscle wasting, and radiation-enhanced carcinogenesis along with potential countermeasures; focus on nutritional interventions and exercise protocols.

4. Prerequisite(s) None

5. Is this a variable credit course? ☐ Yes ☑ No If yes, from ________ to ________.

6. Is this a repeatable course? ☐ Yes ☑ No If yes, this course may be taken ________ times. Will the course be repeated within the same semester/term? ☐ Yes ☑ No

7. Has this course been taught as a 489/689? ☐ Yes ☑ No If yes, how many times? ________ Indicate the number of students enrolled for each academic period it was taught. 5

8. This course will be:
   a. required for students enrolled in the following degree program(s) (e.g., B.A. in history) Texas A&M University Ph.D. Training Program in Space Life Sciences
   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography) An elective for M.S./Ph.D. students in Nutrition, Kinesiology, and Nuclear Engineering (Health Physics)

9. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with those departments. Attach approval letters.

10. Prefix KINE 646 Course # FUND SPACE LIFE SCIENCES

<table>
<thead>
<tr>
<th>Lect.</th>
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Approval recommended by:

Head of Department
Raymond J. 11/9/07

Chair College Review Committee
Michael L. McBee 11/10/07

Submitted to Coordinating Board by:

Director of Academic Support Services

To have this form reviewed, please send to Linda F. Lacey, Mail Stop 1265 or fax to 847-8737.
OAR/AS-504
Nutrition, Nuclear Engineering, Kinesiology 646
(NUTR/NUEN/KINE 646, Section 600)
Fundamentals of Space Life Sciences
Course Syllabus, Fall, 2007

Instructor: Nancy D. Turner, Ph.D. 212 Kleberg, 847-8714
n-turner@tamu.edu

Time/Location: 9:30 – 10:45, Rm. 213 Kleberg

Textbook: All materials will be from original journal articles,
supplemented with references to text books as appropriate.
All reading materials will be posted on the web and
students are required to access these materials through the
Texas A&M web based system.

Course Description: This course is designed to integrate nutrition, biochemistry,
physiology and radiation biology to define the major
biological problems encountered in long duration space
flight. It will provide an overview of each of these
problems with potential countermeasures against the
problems. Countermeasure development will focus
primarily on nutrition and exercise protocols to counter
problems of bone loss, muscle wasting, and radiation-
enhanced carcinogenesis. Experts in each of these areas
will have a good understanding of the major biological
problems facing long duration space flight, and their
countermeasures.

Prerequisites: An undergraduate degree in Nutrition, Kinesiology or
Health Physics or similar qualifications. Contact instructor
for further guidance in this area.

Course Objectives: With successful completion of the course, you will have
achieved:

1. An integrated understanding of the major life science problems encountered during
long duration space flight.
2. An integrated understanding of the primary agencies involved in long duration space
flight (NASA, NSBRI, ESA) and the types of research models used to assess the severity
of physiological changes occurring during long duration space flight and the potential of
countermeasures to ameliorate these problems.
3. An integrated understanding of countermeasures against the critical problems of long
duration space flight and history of what has and has not worked to date.
**Evaluation:** Exams - 3 (100 points each)  
Oral presentation on a problem of long duration space flight and a proposed countermeasure (choose a topic outside of your own graduate degree program)  
Paper describing the topic of oral presentation  

TOTAL  
600 points

**Grading Scale:**  
90-100% A  
80-89 B  
70-79 C  
60-69 D  
59% and below F

**Make-up Policy:** Make-up examinations will be given only for university authorized absences. It is the student's responsibility to arrange a date and time with the instructor. If possible, students should make arrangements prior to the scheduled examination time.

The oral presentation will be given during the last two weeks of regular classes. Papers will be due the week before finals. The papers need to be 10-12 double spaced pages (1 inch margins and 12 point font) and the information presented should be supported by results from original research articles (n > 15) and review articles (no more than 5).

**Americans with Disabilities Act (ADA) Policy Statement:** The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Room B118 of Cain Hall, call 845-1637 or visit: http://disability.tamu.edu.

**Academic Integrity Statement:** All syllabi shall contain a section that states the Aggie Honor Code and refers the student to the Honor Council Rules and Procedures on the web (http://www.tamu.edu/aggiehonor/index.html). All students should make themselves aware of correct citation techniques by reviewing the Academic Integrity Tutorials available on the library web site (http://library.tamu.edu/portal/site/Library).

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LECTURE SCHEDULE

8/27 Introduction to the course, content and methods of evaluation. The role of NASA and NSBRI in space life sciences. (Turner)

8/29 Space physiology, overview. The space environment and how it differs from earth. Major research methods and techniques to study space-related problems and their countermeasures. (Bloomfield)

9/3 Bone loss and risk of fracture and renal stones I (Bloomfield)
9/5 Bone loss and risk of fracture and renal stones II (Bloomfield)

9/10 Sleep disruptions, impact on performance (Dinges – video)
9/12 Skeletal muscle atrophy, changes in muscle function (Fluckey)

9/17 Altered muscle protein synthesis and degradation (Lawler)
9/19 Cardiovascular changes: orthostatic intolerance, distribution of blood flow and impact on aerobic work capacity (Woodman)

9/24 Exam: Space physiology

9/26 Space Nutrition: Space flight and ground based research in nutrition and review of space food, intake patterns (Turner)

10/1 Depressed food intake and its consequences (Lupton)
10/3 Protein and amino acid turnover - relationship to loss of muscle mass (Wu)

10/8 Lipid metabolism – role in signaling pathways (Chapkin)
10/10 Mineral requirements, balance studies and other measures of turnover, e.g. Calcium (Smith)

10/15 Antioxidants and other vitamin roles in space (Walzem/Turner)
10/17 Interaction of nutrition with radiation (Turner)

10/22 Exam: Space Nutrition

10/24 Space Radiation: Radiation and radiation production (Braby)

10/29 The space radiation environment, solar cycle and regions of space (Braby)
10/31 Radiation detection and measurement (Braby)

11/5 Physical countermeasures against radiation (Braby)
11/7 Radiation chemistry and DNA damage and repair (Ford)

11/12 Biological effects of high and low LET radiation, synergistic effects of microgravity/altered gravity and radiation (Ford)
11/14 Biological effects of space radiation observed in astronauts, radiation protection and regulations for space flight (Ford)

11/19 Biomedical countermeasures to radiation exposure (Ford)
11/21 EXAM: Space Radiation

11/26 Student presentations
11/28 Student presentations

12/3 Redefined day – Friday classes (could use this time instead of 12/10)
12/5 Reading day, no classes
12/10 Student presentations, class evaluation
Texas A&M University

Departmental Request for a New Course

Undergraduate • Graduate • Professional

Submit original form and 2 copies. Attach a course syllabus to each.

1. This request is submitted by the Department of Nuclear Engineering

2. Course prefix, number and complete title NUEN 646

3. Course description (not more than 50 words) Integrate nutrition, physiology, and radiation biology to define major biological problems in long duration space flight; provide an overview of the problems of bone loss, muscle wasting, and radiation-enhanced carcinogenesis along with potential countermeasures; focus on nutritional interventions and exercise protocols.

4. Prerequisite(s) None Cross-listed with NUTR 646 & KINE 646

5. Is this a variable credit course? □ Yes □ No If yes, from ______ to _______.

6. Is this a repeatable course? □ Yes □ No If yes, this course may be taken ______ times. Will the course be repeated within the same semester/term? □ Yes □ No

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8. This course will be:
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   Texas A&M University Ph.D. Training Program in Space Life Sciences

   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography)

   An elective for M.S./Ph.D. students in Nutrition, Kinesiology, and Nuclear Engineering (Health Physics)

9. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

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Approval recommended by:

Head of Department 11/9/07

Chair, College Review Committee 11/9/07

Dean of College 11/9/07

Submitted to Coordinating Board by:

Director of Academic Support Services

Effective Date

To have this form reviewed, please send to Linda F. Lacey, Mail Stop 1265 or fax to 847-8737.

OAR/AS-5/04
Nuclear Engineering 646 (NUEN 646)
Fundamentals of Space Life Sciences
Course Syllabus, Fall, 2007
(Cross-listed with NUTR 646 & KINE 646)

Instructor: Nancy D. Turner, Ph.D.  212 Kleberg, 847-8714
            n-turner@tamu.edu

Time/Location: 9:30 – 10:45, Rm. 213 Kleberg

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Prerequisites: An undergraduate degree in Nutrition, Kinesiology or
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long duration space flight.
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flight (NASA, NSBRI, ESA) and the types of research models used to assess the severity
of physiological changes occurring during long duration space flight and the potential of
countermeasures to ameliorate these problems.
3. An integrated understanding of countermeasures against the critical problems of long
duration space flight and history of what has and has not worked to date.
**Evaluation:** Exams - 3 (100 points each) 300 points
Oral presentation on a problem of long duration space flight and a proposed countermeasure (choose a topic outside of your own graduate degree program) 150 points
Paper describing the topic of oral presentation 150 points

TOTAL 600 points

**Grading Scale:**

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