Texas A&M University  
Departmental Request for a New Course  
Undergraduate • Graduate • Professional  
• Submit original form and attach a course syllabus.

Form Instructions  
1. Course request type:  
☐ Undergraduate  ☑ Graduate  ☐ First Professional (DMD, MD, JD, PharmD, DVM)

2. Request submitted by (Department or Program Name):  
Department of Animal Science

3. Course prefix, number and complete title of course:  
ANSC 641: Nutritional Biochemistry I

4. Catalog course description (not to exceed 50 words):  
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 and disease conditions; functions of vitamins and minerals in nutrient metabolism and health.

5. Prerequisite(s):  
BICH 411 NUTR 470 ANSC/NUTR 601

Cross-listed with:  
NUTR 641

Stacked with:  
Cross-listed courses require the signature of both department heads.

6. Is this a variable credit course?  
☐ Yes  ☑ No

If yes, from _______ to _______.

7. Is this a repeatable course?  
☐ Yes  ☑ No

If yes, this course may be taken ______ times.

Will this course be repeated within the same semester?  
☐ Yes  ☑ No

Will this course be submitted to the Core Curriculum Council?  
☐ Yes  ☑ No

8. How will this course be graded:  
☑ Grade  ☐ S/U  ☐ P/F (CL/MD)

9. Cross-Listed courses require the signature of both department heads.

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

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

H. Russell Cross  
Department Head or Program Chair (Type Name & Sign)  
Date

David Reed  
Chair, College Review Committee  
Date

Mark Hussey  
Dean of College  
Date

Dean of College  
Date

Chair, GC or UCC  
Date

Questions regarding this form should be directed to Sandra Williams at 845-8201 or sandra.williams@tamu.edu.
NUTR/ANSC 641: Nutritional Biochemistry

Fall 20XX

Tuesdays and Thursdays: 9:35 am - 10:50 am; Room 300, Kleberg Center

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

Grading: Mid-Term Exams, weeks 4 and 8, 30% (2 x 15%); Final Exam, week 15, (50%); Term-paper, week 15 (20%)

A=90 and above
B=80-89.9
C=70-79.9
D=60-69.9
F=59.9 and below

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/NUTR 601, and BICH 411.


The following texts are recommended for basic knowledge of the subject:
**Journals:** Recent papers will be selected from journals for this course. Examples of the journals are *American Journal of Physiology*, *Amino Acids*, *Biochemical Journal*, *Biochimica et Biophysica Acta*, *Comparative Biochemistry and Physiology*, *Journal of Biological Chemistry*, *Journal of Nutrition*, *Journal of Nutritional Biochemistry*, *Nature*, and *Science*

**Class discussion:** Students are encouraged to ask questions and actively participate in discussion.

**Americans with Disabilities Act (ADA) Policy Statement**
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 Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit http://disability.tamu.edu.

**Academic Integrity Statement and Policy**
"An Aggie does not lie, cheat or steal or tolerate those who do."
http://aggiehonor.tamu.edu

**Attendance Policies:**
Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make-up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://studentrules.tamu.edu). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1) Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2) Death or major illness in a student's immediate family.
3) Illness of a dependent family member.
4) Participation in legal proceedings or administrative procedures that require a student's presence.
5) Religious holy day. NOTE: Prior notification is NOT required.
6) Injury or illness that is too severe or contagious for the student to attend class.
   a) Injury or illness of three or more class days:
      Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   b) Injury or illness of less than three class days:
      Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      (i.) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu
      (ii.) Confirmation of visit to a health care professional affirming date and time of visit.
c) An absence for a non-acute medical service does not constitute an excused absence.
7) Required participation in military duties.
8) Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9) Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10) In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor. Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.
In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.
Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.
Approvals FS.26.15, FS.26.86, FS.30.024, FS.31.88 Revised
Course Schedule NUTR/ANSC 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 $HCO_3^-/CO_2$ buffer system in the body
e. Renal ammoniagenesis and generation of $HCO_3^-$ 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