Job Analysis for the Nutrition Specialty Exam

Conducted on behalf of the:

American College of Veterinary Internal Medicine (ACVIM)

June 29, 2023

Prepared by:

PROMETRIC

Colvin Franklin, M.S.
Assessment Services

ACKNOWLEDGEMENTS

We would like to thank the many individuals who provided invaluable assistance throughout the conduct of the job analysis for the American College of Veterinary Internal Medicine (ACVIM) Nutrition Specialty (NUTRITION) Exam.

Above all, we thank the dedicated professionals who generously contributed their time and expertise. In particular, we would like to thank the 12 subject matter experts who participated in the in-person Job Analysis Panel.

At ACVIM, Nicole Finn, Senior Director of Certification and Accreditation and Annie Blagg, Senior Manager, Certification and Accreditation Program, provided outstanding guidance throughout the project.

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EXECUTIVE SUMMARY

"The American College of Veterinary Internal Medicine (ACVIM) is a not-for-profit 501(c)(6) organization dedicated to improving the lives of animals and people through education, training and certification of specialists in veterinary internal medicine, discovery and dissemination of new medical knowledge, and increasing public awareness of advances in veterinary medical care."[1]

ACVIM requested a Job Analysis Study from Prometric for their Nutrition Specialty (NUTRITION) Exam. A job analysis is designed to obtain descriptive information about the tasks performed on a job and the knowledge needed to adequately perform those tasks. The purpose of this job analysis was to:

- develop tasks and knowledge related to the work performed by veterinarians specializing in nutrition; and,
- update the content outline for the NUTRITION Exam.

Conduct of the Job Analysis

The job analysis consisted of several activities: background research; a panel expert review; and development of the content outline for the NUTRITION Exam. The successful outcome of the job analysis depended on the information provided by industry professionals who participated in the study.

Background Research

The development of task and knowledge statements commenced with a desk study of relevant information on the ACVIM NUTRITION Exam. These materials were provided by ACVIM with additional information gathered from online resources. During the desk study process, interviews were conducted with individuals specializing in veterinary nutrition.

Panel Review/Content Outline Development

An expert panel convened in Philadelphia, Pennsylvania on June 12th and 13th, 2023. The panel of experts was presented with the purpose of the NUTRITION Exam and the purpose of conducting a job analysis. The panel then reviewed a draft of tasks along with knowledge, skill, and ability (KSA) statements. The panel made additional changes and reached consensus regarding the final list of tasks and KSAs.

The expert panel used the final version of the approved list of tasks and KSAs to create the test specifications for each of the three NUTRITION Exam sections. These test specifications will guide future development activities for the NUTRITION Exam.

Summary

In summary, this study used a sound approach to identify the tasks and KSAs that are important to the competent performance of veterinarians specializing in nutrition. The job analysis process allowed for input from a representative group of professionals who currently practice in the field and was conducted within the guidelines of professionally sound practice. The results of the job analysis can be used by ACVIM to update the NUTRITION Exam.

[1] https://www.acvim.org/about-acvim Retrieved June 26th, 2023

INTRODUCTION

"The American College of Veterinary Internal Medicine (ACVIM) is a not-for-profit 501(c)(6) organization dedicated to improving the lives of animals and people through education, training and certification of specialists in veterinary internal medicine, discovery and dissemination of new medical knowledge, and increasing public awareness of advances in veterinary medical care."[2]

The central focus of this job analysis was to identify the tasks and knowledge, skills, and abilities (KSAs) that are important for competent performance as a veterinarian specializing in nutrition. The development of a content-valid credentialing program is based on tasks and knowledge identified through the job analysis process.

This report describes the job analysis, including the:

- rationale for conducting the job analysis;
- methods used to define job-related tasks and KSAs; and,
- creation of the final content outline for the Nutrition Specialty (NUTRITION) Exam.

Job Analysis Study and Adherence to Professional Standards

Job analysis refers to procedures designed to obtain descriptive information about the tasks performed on a job and/or the knowledge, skills, or abilities necessary to adequately perform those tasks. The specific type of information collected during a job analysis is determined by the purpose for which the information will be used.

For purposes of developing credentialing programs, a job analysis should identify important tasks, knowledge, skills, and/or abilities deemed to be important by professionals specializing in veterinary nutrition.

The use of a job analysis (also known as practice analysis, role and function study, or role delineation study) to define the content domain(s) is a critical component in establishing the content validity of a program. Content validity refers to the extent to which the content covered by a program is representative of the tasks and knowledge required for a particular job.

A well-designed job analysis should include a representative group of subject-matter experts who reflect the diversity within the profession. Diversity refers to regional or job context factors and to subject-matter expert factors such as experience, gender, and race/ethnicity. Demonstration of content validity is accomplished through the judgments of subject-matter experts. The process is enhanced by the inclusion of subject-matter experts who represent the diversity of all relevant areas of expertise.

[2] https://www.acvim.org/about-acvim Retrieved June 26th, 2023

The Standards for Educational and Psychological Testing[3] (2014) (*The Standards)* is a comprehensive technical guide that provides criteria for the evaluation of tests, testing practices, and the effects of test use. It was developed jointly by the American Psychological Association (APA), the American Educational Research Association (AERA), and the National Council on Measurement in Education (NCME). The guidelines presented in *The Standards*, by professional consensus, have come to define the necessary components of quality testing. As a consequence, a testing program that adheres to *The Standards* is more likely to be judged as valid and defensible than one that does not.

As stated in Standard 11.13,

> "The content domain to be covered by a credentialing test should be defined clearly and justified in terms of the importance of the content for credential-worthy performance in an occupation or profession. A rationale and evidence should be provided to support the claim that the knowledge or skills being assessed are required for credential-worthy performance in that occupation and are consistent with the purpose for which the credentialing program was instituted…. Typically, some form of job or practice analysis provides the primary basis for defining the content domain…" (p. 181-182)

The job analysis for the NUTRITION Exam was designed to follow the guidelines presented in *The Standards* and to adhere to accepted professional practice.

[3] American Educational Research Association, American Psychological Association, National Council on Measurement in Education. (1999). *The Standards for Educational and Psychological Testing*. Washington, DC: American Psychological Association.

METHOD

The job analysis for the NUTRITION Exam involved a methodical approach focused on an expert panel review. A draft list of tasks and KSAs was developed using the current content outline, previous job analysis study, and results of the desk study. Additional information was also provided by ACVIM. The draft task and KSAs were reviewed by a panel of experts, selected by ACVIM to serve as the Job Analysis Panel. The purpose of the expert panel review was to obtain verification (or refutation) that the tasks and KSAs identified are important to the work of veterinarians specializing in nutrition.

Utilizing multiple experts to create and review the tasks and KSAs functions as a "check and balance" on the judgments of the initial background research and reduces the likelihood that unimportant areas will be considered in the development of the test specifications. The use of multiple experts reduces the likelihood that one expert's input will influence the entire content outline.

The methodology used to conduct the job analysis is described in detail below and included the following steps:

1. Conduct of Planning Meeting

Project-planning discussions were held via email and conference calls between ACVIM and Prometric. Meeting participants included ACVIM and Prometric staff responsible for the conduct of the job analysis.

During the planning discussions, several issues were explored, including expert selection, meeting dates, logistics, and job analysis methodologies.

2. Development of the Tasks and KSAs

A pre-meeting document was sent to the Panel containing information about the job analysis and the best practices for developing tasks and KSAs. A copy of the pre-meeting document is included as Appendix A.

3. Expert Panel Review

The expert panel met in Philadelphia, Pennsylvania on June 12th and 13th, 2023. The Job Analysis Panel was comprised of 12 experts in the field of veterinary nutrition. A complete list of the SMEs who participated in the job analysis is in Appendix B.

Prometric staff led the Panel through the review, revision, and development of tasks and KSAs. The final list of tasks and KSAs was divided into the following domains:

1. Nutritional Biochemistry and Requirements
2. Nutritional Physiology and Pathophysiology
3. Assessment of Individual/Group
4. Dietary Assessment and Feeding Practice
5. Develop a Nutritional Plan for the Individual/Group
6. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods

4. Development of the Test Specifications

The job analysis meeting resulted in updated test specifications for all three sections of the NUTRITION Exam. The specifications were created following the panel discussion on important tasks and KSAs. Once the final list of tasks and KSAs for each of the content areas was approved, these topics were then distributed across the various exam sections.

A total of 57 tasks and KSAs were identified by the Job Analysis Panel as important to competent performance as a veterinarian specializing in nutrition. Table 1 lists these items by content area.

Table 1: Approved Tasks and KSAs

Content Area	Task/KSA
Nutritional Biochemistry and Requirements	Demonstrate knowledge of definitions, classifications, metabolism, functions, and interactions of the following nutrients: carbohydrates including fiber; lipids; proteins and other nitrogen-containing compounds; vitamins, vitamin-like, and other functional compounds; minerals; and water
Nutritional Biochemistry and Requirements	Demonstrate knowledge of nutritional aspects of acid-base regulation
Nutritional Biochemistry and Requirements	Demonstrate knowledge of comparative aspects of nutritional biochemistry and requirements
Nutritional Biochemistry and Requirements	Describe the derivation and application of nutritional requirements (e.g., minimal vs. adequate vs. recommended vs. safe upper limits/maximum tolerable level vs. toxic, allometry)
Nutritional Biochemistry and Requirements	Demonstrate knowledge of intake for an animal and its relationship to nutrient requirements (e.g., bioavailability)
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of physiology (e.g., Alimentary/Digestive, Endocrine, Metabolic, Urinary and Renal, Immunologic, Cardiorespiratory, Musculoskeletal, Neoplastic, Pancreatic, Hepatic, Dermatological, Neurological/Cognitive)
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of nutrient-gene interactions (e.g., epigenetics, breed differences)
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of age-, life stage-, sex-, breed- or species-related nutritional physiology and pathophysiology
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of the prevention and pathophysiology of diet-induced and nutrient sensitive diseases
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of the regulation of appetite and control of food intake
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of the causes and consequences of altered body composition (e.g., cachexia, sarcopenia, obesity) and methods of assessment
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of the pathophysiology of starvation and catabolic disease
Nutritional Physiology and Pathophysiology	Demonstrate knowledge of nutrient-drug interactions
Assessment of Individual/Group	Recognize age-, life stage-, sex-, breed- or species-related susceptibility to nutritional problems

Assessment of Individual/Group	Interpret body weight, body condition, muscle mass, and changes over time
Assessment of Individual/Group	Recognize physical signs and interpret laboratory results of diet-induced or nutrient sensitive conditions (e.g., imaging, clinical pathology tests)
Assessment of Individual/Group	Identify candidate for assisted nutritional support (e.g., enteral, parenteral)
Assessment of Individual/Group	Ability to evaluate status and nutritional considerations of the following life stages; maintenance; growth (pre-weaning and post-weaning); reproduction; production/lactation; and working/performance
Assessment of Individual/Group	Evaluate status and nutritional considerations for the following diseases/conditions (individually or in combination); Gastrointestinal; Endocrine; Metabolic; Urinary and Renal; Cardiorespiratory; Musculoskeletal; Dental; Neoplastic; Pancreatic; Hepatic; Dermatological; Neurological/Cognitive; Obesity; Starvation; and Critical illness (e.g., trauma, sepsis, peri-operative)
Dietary Assessment and Feeding Practice	Obtain accurate and complete diet/ration history, including treats, supplements, and foods for medication administration
Dietary Assessment and Feeding Practice	Determine energy, dry matter, and nutrient intake
Dietary Assessment and Feeding Practice	Assess adequacy of energy, dry matter, and nutrient intake relative to individual/group requirements
Dietary Assessment and Feeding Practice	Evaluate non-nutritive feed additives and growth promotants
Dietary Assessment and Feeding Practice	Describe nutritional implications of food/feed forms (e.g., forage forms, commercial feed types [large animal and small animal], homemade)
Dietary Assessment and Feeding Practice	Assess nutritional implications of environmental factors (e.g., season/climate, feed competition, stress, enrichment)
Dietary Assessment and Feeding Practice	Develop a species appropriate plan to sample and analyze food/feed/water (e.g., nutrient content, contaminants, forage analysis)
Dietary Assessment and Feeding Practice	Interpret the results of food/feed/water laboratory analyses and formulation software
Dietary Assessment and Feeding Practice	Evaluate company provided information (e.g., feed/ingredient labels, website information, product guides)
Dietary Assessment and Feeding Practice	Evaluate nutritional value of ingredients and effect of processing
Dietary Assessment and Feeding Practice	Demonstrate knowledge of implications of and indications for specific feeding practices (e.g., frequency, location)
Dietary Assessment and Feeding Practice	Assess relative nutritional and economic value of feeding systems (e.g., nutrition modeling)
Dietary Assessment and Feeding Practice	Recognize diet related toxicosis (e.g., toxic plants, contaminants, nutrients, microbial)
Develop a Nutritional Plan for the Individual/Group	Assess the animal's nutritional considerations compared to current diet/ration

Develop a Nutritional Plan for the Individual/Group	Develop a prioritized nutritionally relevant problem list and differential diagnosis list
Develop a Nutritional Plan for the Individual/Group	Develop a diagnostic plan and interpret results (e.g., imaging, clinical pathologic tests)
Develop a Nutritional Plan for the Individual/Group	Demonstrate knowledge of principles of ration/recipe formulation
Develop a Nutritional Plan for the Individual/Group	Formulate an appropriate ration/recipe to meet specific considerations (e.g., cost, environmental sustainability, ingredient restrictions, ingredient accessibility, palatability)
Develop a Nutritional Plan for the Individual/Group	Incorporate assessment findings to develop a feeding plan (e.g., diet, treats, supplements, medications, amounts, feeding method) based on prioritization of needs
Develop a Nutritional Plan for the Individual/Group	Establish a monitoring program for individual/group
Develop a Nutritional Plan for the Individual/Group	Evaluate individual/group response to feeding plan and modify as needed
Develop a Nutritional Plan for the Individual/Group	Demonstrate knowledge of nutritional and pharmacological methods to manage animals with altered appetites
Develop a Nutritional Plan for the Individual/Group	Demonstrate knowledge of assisted feeding tube selection, placement technique, management, and potential complications, including specific dietary recommendations and fluid administration
Develop a Nutritional Plan for the Individual/Group	Demonstrate knowledge of catheter selection, formulation, institution, and monitoring of parenteral nutrition and fluid administration
Develop a Nutritional Plan for the Individual/Group	Describe characteristics of the components used in parenteral nutrition
Develop a Nutritional Plan for the Individual/Group	Communicate the feeding plan to relevant parties
Develop a Nutritional Plan for the Individual/Group	Provide rationale for the feeding plan
Develop a Nutritional Plan for the Individual/Group	Answer feeding plan questions
Develop a Nutritional Plan for the Individual/Group	Utilize techniques to increase client's adherence to feeding plan or nutritional recommendations
Develop a Nutritional Plan for the Individual/Group	Address misconceptions regarding nutrition, diets, and ingredients
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Demonstrate knowledge of principles of manufacturing and food science (e.g., processing, quality control, safety, preservatives)
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Demonstrate knowledge of the procurement and handling of ingredients as sources of nutrients (e.g., bioavailability, digestibility, storage/handling techniques, soil quality as determined by soil testing)

Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Demonstrate knowledge of sustainability and environmental implications of feeding practices
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Demonstrate knowledge of safe storage and analysis procedures for contamination
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Demonstrate knowledge of regulations and labeling
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Evaluate quality of nutritional information from various sources (e.g., internet, marketing claims, scientific literature, product guides)
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Evaluate study design and appropriate application of statistics/epidemiology
Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	Demonstrate knowledge of food/feed analytical methods and their limitations

Once the committee approved the tasks and KSAs, they discussed which content areas should be covered on each of the three NUTRITION Exam sections. It was determined that Section 1 should consist of multiple-choice items that were not specific to any one animal type, Section 2 should consist of multiple-choice items focused on practice with either small or large animals, and Section 3 would consist of essays and other higher cognitive level items. The SMEs determined that the following domains should be covered in each section:

Section 1:

1. Nutritional Biochemistry and Requirements
2. Nutritional Physiology and Pathophysiology
6. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods

Section 2:

1. Nutritional Biochemistry and Requirements
2. Nutritional Physiology and Pathophysiology
3. Assessment of Individual/Group
4. Dietary Assessment and Feeding Practice
5. Develop a Nutritional Plan for the Individual/Group
6. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods

Section 3:

3. Assessment of Individual/Group
4. Dietary Assessment and Feeding Practice
5. Develop a Nutritional Plan for the Individual/Group

After selecting the topics to be covered by each exam section, the Panel created content weights for each of the domains. This was accomplished by having each of the participants give their individual estimates, entering those estimates into a spreadsheet, and discussing the aggregated data. Tables 2-5 below shows each domain, the percentage weights assigned, and the total number of items, as finalized by the Job Analysis Panel, by exam section.

Table 2: Weighting Exercise - Section 1

Domain	Percentage Weight	Number of Test Points
1. Nutritional Biochemistry and Requirements	50%	50
2. Nutritional Physiology and Pathophysiology	30%	30
6. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	20%	20

Table 3: Weighting Exercise - Section 2

Domain	Percentage Weight	Number of Test Points
1. Nutritional Biochemistry and Requirements	10%	10
2. Nutritional Physiology and Pathophysiology	10%	10
3. Assessment of Individual/Group	20%	20
4. Dietary Assessment and Feeding Practice	25%	25
5. Develop a Nutritional Plan for the Individual/Group	25%	25
6. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	10%	10

Table 4: Weighting Exercise - Section 3

Domain	Percentage Weight	Number of Test Points
3. Assessment of Individual/Group	30%	90
4. Dietary Assessment and Feeding Practice	35%	105
5. Develop a Nutritional Plan for the Individual/Group	35%	105

Table 5: Weighting Exercise - Overall

Domain	Percentage Weight	Number of Test Points
1. Nutritional Biochemistry and Requirements	12%	60
2. Nutritional Physiology and Pathophysiology	8%	40
3. Assessment of Individual/Group	22%	110
4. Dietary Assessment and Feeding Practice	26%	130
5. Develop a Nutritional Plan for the Individual/Group	26%	130
6. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods	6%	30

The test specifications each of the three NUTRITION Exam sections created during the panel job analysis meeting are located in Appendix C.

5. Assessment Design Meeting and Updates

On August 21, 2023, Prometric, ACVIM, and a group of veterinary nutrition specialists met to finalize the NUTRITION Exam structure. During this meeting it was determined that the exam would consist of two, rather than three, sections. This reduction in sections was created by combining Section 1 and Section 2 into one multiple-choice section. Section 3 remained unchanged.

The final approved test specifications for the two-section NUTRITION Exam is located in Appendix D.

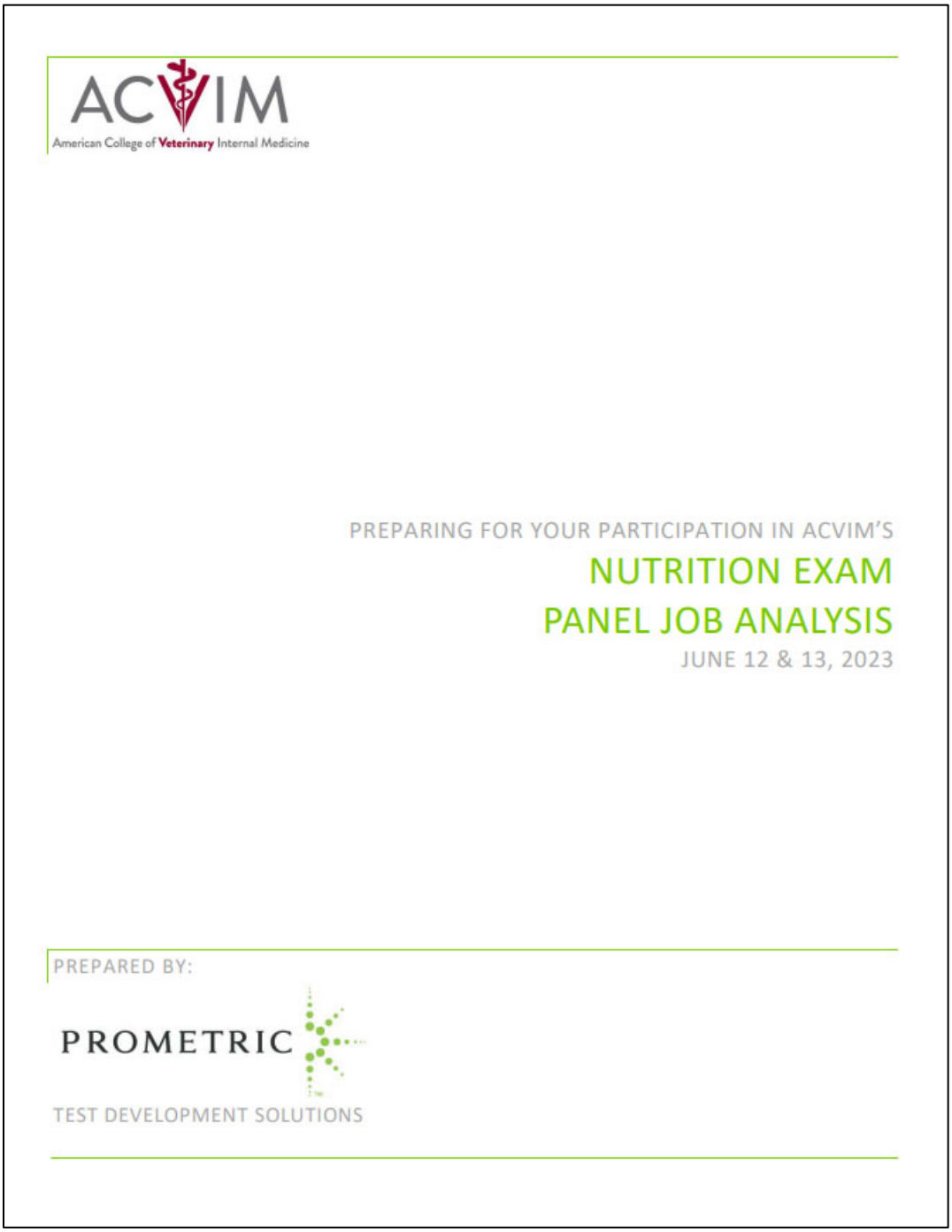
SUMMARY AND CONCLUSION

The job analysis for the ACVIM NUTRITION Exam was conducted to:

- identify tasks and KSAs important to the work performed by veterinarians specializing in nutrition; and,
- create test specifications that may be used as guidance for the NUTRITION Exam.

The tasks and KSAs were developed through an iterative process involving the combined efforts of subject matter experts, ACVIM, and Prometric staff. The tasks and KSAs were verified as important through the review of experts and provide the foundation for development for the NUTRITION Exam. In summary, the job analysis utilized a multi-method approach to identify the tasks and KSAs important to the work performed by veterinarians specializing in nutrition. The test specifications that resulted from the job analysis process can be utilized in all future NUTRITION Exam development activities.

APPENDIX A: Pre-Meeting Document



INTRODUCTION

The American College of Veterinary Internal Medicine (ACVIM) has commissioned a panel job analysis for its Nutrition Exam from Prometric.

A job analysis is designed to obtain descriptive information about the tasks performed in a job and the knowledge, skills, and abilities (KSAs) needed to support the performance of those activities. The purpose of this job analysis is to:

- review and revise the list of KSAs related to work performed by veterinarians specializing in nutrition, and
- develop test specifications for the Nutrition Exam.

PREPARING FOR THE PANEL JOB ANALYSIS

This document provides information to prepare you for participation in the panel job analysis, including:

- the meeting schedule and agenda,
- a summary of the job analysis process,
- information on the creation/revision of KSAs, and
- an overview of the test specification development process.

Colvin Franklin, a Prometric Assessment Design Specialist, will serve as the meeting facilitator.

PARTICIPATING IN A JOB ANALYSIS MEETING

During the meeting, we will define the major content areas (domains) along with the major tasks performed and the KSAs needed for competent performance. The information produced in this meeting will form the test specifications, or blueprint for the Nutrition Exam.

Your role—along with the other panel members— is to actively provide information during the meeting based on your professional expertise about the work performed by individuals practicing as nutrition specialists.

On behalf of ACVIM, we welcome you as a critical contributor to this important project by serving on the Job Analysis Panel!

ABOUT THE MEETING

ACCOMMODATIONS & MEETING LOCATION

Philadelphia Marriott Downtown

1201 Market Street, Philadelphia, PA 19107

Independence Ballroom, Salon II (Level 3)

(215) 625-2900

www.marriott.com/en-us/hotels/phldt-philadelphia-marriott-downtown

MEETING SCHEDULE

MONDAY, JUNE 12

START TIME:	8:00 am
BREAK:	Mid-Morning
LUNCH:	Noon *(in meeting room)*
BREAK:	Mid-Afternoon
ADJOURNMENT:	5:00 pm

TUESDAY, JUNE 13

START TIME:	8:00 am
BREAK:	Mid-Morning
LUNCH:	Noon *(in meeting room)*
BREAK:	Mid-Afternoon
ADJOURNMENT:	3:00 pm

AGENDA

- Welcome and introductions
- Overview of the job analysis process
- Creation/revision of KSAs
- Development of test specifications
  - Recommendations regarding test content
  - Recommendations regarding test weights
- Mapping of previous exam content to new test specifications

JOB ANALYSIS DEFINED

A job analysis (also known as a job task analysis, practice analysis, role and function study, body of knowledge study, or role delineation) refers to procedures designed to obtain descriptive information about the professional activities performed on a job and the important knowledge, skills, and abilities (KSAs) needed to competently perform those professional activities. The specific type of job information collected for a job analysis is determined by the purpose for which the information will be used. For purposes of developing certification examinations, a job analysis should identify important KSAs necessary for competent performance.

In addition, a well-designed job analysis should reflect the diversity within the job. Diversity refers to regional or job context factors (e.g., geographic region, practice setting) and to subject matter expert factors (e.g., professional experience, gender).

ADHERENCE TO THE STANDARDS FOR EDUCATIONAL & PSYCHOLOGICAL TESTING

Job analyses conducted by Prometric are designed to adhere to professional practice guidelines presented in *The Standards for Educational and Psychological Testing* (1999) (*The Standards*).

The Standards is a comprehensive technical guide that provides criteria for the evaluation of tests, testing practices, and the effects of test use. It was developed jointly by the American Psychological Association (APA), the American Educational Research Association (AERA), and the National Council on Measurement in Education (NCME). The guidelines presented in *The Standards* have, by professional consensus, come to define the necessary components of quality testing. Consequently, a testing program that adheres to *The Standards* is more likely to be judged valid and defensible than one that does not.

The Standards emphasize the concept of content validity and the need to conduct a job analysis to assure that the knowledge assessed in credentialing initiatives are in fact limited to those important for competent performance. As noted in Standard 14.14, *"The content domain to be covered by a credentialing test should be defined clearly and justified in terms of the importance of the content for credential-worthy performance in an occupation or profession. A rationale should be provided to support a claim that the knowledge or skills being assessed are required for credential-worthy performance in an occupation and are consistent with the purpose for which the licensing or certification program was instituted."* (pg 161)

OBJECTIVES OF THE JOB ANALYSIS

The objectives of the study are two-fold: (1) to construct with subject-matter experts a comprehensive delineation of KSAs related to important work activities, and (2) to create Test Specifications that incorporate those KSAs.

JOB ANALYSIS: DELINEATION OF DOMAINS, TASKS, AND KSAs

The major aim of conducting a job analysis is to develop a concise and logical compilation of what professionals do in specific terms that can be readily communicated and understood. The delineation procedure involves a number of steps including the identification of (1) domains, (2) tasks, and (3) KSAs underlying the performance of the tasks.

1. Domains: These are also known as topic areas, content areas, or dimensions and represent the:
    a. professional responsibilities
    b. knowledge needed to perform one's professional responsibilities

    These may be characterized as major headings in an outline format and may include a brief behavioral description of the domain.
2. Tasks: When all domains have been identified, each domain will be described in terms of the tasks performed to fulfill important job responsibilities. The tasks identified by the Job Analysis Panel must cover all aspects of the work that are relevant to the objectives of the study.
3. KSAs: After the domains and tasks have been compiled, the knowledge/skills associated with the performance of activities are identified.

EXAMPLE: DOMAINS (CONTENT AREAS)

Below is *an example* of the aforementioned hierarchy.

1. Nutritional Biochemistry and Requirements

Demonstrate knowledge of definitions, classifications, metabolism, functions, interactions, deficiencies, and toxicity of the following nutrients:

1. Carbohydrates including fiber
2. Lipids
3. Proteins and other nitrogen-containing compounds
4. Vitamins and vitamin-like compounds
5. Minerals
6. Water

Demonstrate knowledge of energy and energetics including measurement methods

Demonstrate knowledge of antioxidants, preservatives, and other functional compounds of the diet

Demonstrate knowledge of nutritional aspects of acid-base regulation

Demonstrate knowledge of species-related nutritional biochemistry

Demonstrate knowledge of nutritional requirements (e.g., minimal vs. recommended vs. adequate vs. safe upper limits vs. toxic levels, allometry)

2. Nutritional Physiology and Pathophysiology

Demonstrate knowledge of nutritional physiology (e.g., digestive, endocrine, urinary, immunology)

Demonstrate knowledge of nutrient-gene interactions

Demonstrate knowledge of nutrient-drug interactions

WRITING TASKS

Tasks are distinct, identifiable, specific job-related activities performed by professionals in your field that are necessary for competent performance. Tasks should begin with action verbs such as:

Administer	Calculate	Counsel	Document	Identify	Interview	Negotiate	Read	Revise
Analyze	Compute	Describe	Establish	Instruct	Maintain	Obtain	Recommend	Schedule
Assess	Conduct	Design	Evaluate	Integrate	Measure	Perform	Report	Supervise
Audit	Consult	Discuss	Formulate	Interpret	Monitor	Plan	Review	Write

A few examples of some *commonly misused* verbs that should be avoided because of ambiguity are:

Assist	Consider	Determine	Help	Know	Participate	Process	Understand

Since tasks vary in complexity, the writer should expect to have statements of varying length and complexity. The following are some examples of appropriately written tasks:

- Interpret body weight, body condition, muscle mass, and changes over time
- Obtain accurate and complete diet/ration history, including treats, supplements, and foods for medication administration
- Describe methods to manage animals with altered appetites

WRITING KSAs

The development of knowledge, skills, and abilities requires inferring behaviors from the tasks. In the writing of these statements, conciseness with specificity is the goal. Adjectives modifying the level or extent of the knowledge (e.g., some, thorough, clearly, effectively) should *not* be used. Doing so introduces a qualifier that is not appropriate or necessary in the job analysis process.

REVIEWING THE KSAs

The following questions will be used to review the draft listing of tasks and KSAs after it has been created:

CLARITY: Are the domains succinct? Are the tasks and KSAs clearly worded?
RELEVANCE: Are the tasks and KSAs relevant to the work performed by individuals practicing as nutrition specialists?
REDUNDANCY: Are the tasks and KSAs unique and discrete?
OMISSIONS: Have any important tasks and KSAs been omitted?
COMPREHENSIVENESS: Are the domains, tasks, and KSAs comprehensive and representative?

RECOMMENDATIONS FOR TEST CONTENT

TEST CONTENT WEIGHTS

The Job Analysis Panel will recommend the content weighting (percentage of items).

The Panel members will be led through an activity where they assign a percentage weight to each KSA domain/subdomain for the Nutrition Exam. After reviewing all relevant information, the Panel will determine the optimal percentage weights for each domain.

The approved test content weights for each part will be used to guide examination development activities including item writing and examination assembly.

APPENDIX B: Subject Matter Experts

Current Position	Years of Experience	Highest Degree	Field of Specialization	Gender	Age	Race/ National Origin	Location
Academia	20 years	Doctorate	Nutrition	*NR*	*NR*	*NR*	Colorado
Senior Specialist Technical Publications	14 years	DVM	Nutrition	Female	41-50	Caucasian/ White	Houston, Texas
Clinical Nutrition Clinician and Consultant	13 years	PhD	Animal Nutrition	Female	41-50	*NR*	*NR*
Director of Scientific Affairs	35 years	DVM; MS	Nutrition	*NR*	*NR*	*NR*	*NR*
Clinical Associate Professor	14 years	MS; DVM	Nutrition	Female	31-40	Caucasian/ White	North Grafton, Massachusetts
Professor of Clinical Nutrition	20 years	PhD	Nutritional Biology	*NR*	*NR*	*NR*	Davis, California
Professor	25 years	DVM; PhD	Nutrition	Female	61+	Caucasian/ White	Minnesota
Professor of Nutrition; Associate Dean for Education	35 years	VMD	Veterinary Medicine	Female	61+	Caucasian/ White	Philadelphia, Pennsylvania
Private Consulting	17 years	DVM	DACVIM (Nutrition)	Female	41-50	Caucasian/ White	*NR*
Clinical Nutritionist	21 years	DVM	Clinical Nutrition	Female	41-50	African American; Caucasian/ White	Los Angeles, California
Pet & Product Support Scientist	10 years	DVM	Nutrition	Female	51-60	Caucasian/ White	Montpellier, France
Scientific Communications Nutritionist	10 years	PhD; DVM	Veterinary Nutrition	Female	41-50	Caucasian/ White	*NR*
Associate Professor	43 years	PhD	Veterinary Medicine	Male	61+	Caucasian/ White	Gainesville, Florida
Professor/Extension Veterinarian	41 years	PhD	Ruminant Nutrition	Male	61+	Caucasian/ White	State College, Pennsylvania

NR= Not reported

APPENDIX C: Test Specifications

Section I: Multiple-Choice

A. Nutritional Biochemistry and Requirements **50%**

1. Demonstrate knowledge of definitions, classifications, metabolism, functions, and interactions of the following nutrients:
    i. Carbohydrates including fiber
    ii. Lipids
    iii. Proteins and other nitrogen-containing compounds
    iv. Vitamins, vitamin-like, and other functional compounds
    v. Minerals
    vi. Water
2. Demonstrate knowledge of energy and energetics including measurement methods
3. Demonstrate knowledge of nutritional aspects of acid-base regulation
4. Demonstrate knowledge of comparative aspects of nutritional biochemistry and requirements
5. Describe the derivation and application of nutritional requirements, including but not limited to:
    i. Minimal vs. adequate vs. recommended vs. safe upper limits/maximum tolerable level vs. toxic
    ii. Allometry
6. Demonstrate knowledge of intake for an animal and its relationship to nutrient requirements, such as:
    i. Bioavailability

B. Nutritional Physiology and Pathophysiology **30%**

1. Demonstrate knowledge of physiology
    i. Alimentary/Digestive
    ii. Endocrine
    iii. Metabolic
    iv. Urinary and Renal
    v. Immunologic
    vi. Cardiorespiratory
    vii. Musculoskeletal
    viii. Neoplastic
    ix. Pancreatic
    x. Hepatic
    xi. Dermatological
    xii. Neurological/Cognitive
3. Demonstrate knowledge of age-, life stage-, sex-, breed- or species-related nutritional physiology and pathophysiology

4. Demonstrate knowledge of the regulation of appetite and control of food intake
5. Demonstrate knowledge of the pathophysiology of starvation and catabolic disease

C. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods **20%**

1. Demonstrate knowledge of principles of manufacturing and food science, including but not limited to:
    i. Processing
    ii. Quality control
    iii. Safety
    iv. Preservatives
2. Demonstrate knowledge of regulations and labeling
3. Evaluate quality of nutritional information from various sources, including but not limited to:
    i. Internet
    ii. Marketing claims
    iii. Scientific literature
    iv. Product guides
4. Evaluate study design and appropriate application of statistics/epidemiology
5. Demonstrate knowledge of food/feed analytical methods and their limitations

Section II: Multiple-Choice (Small or Large Animal Specific)

A. Nutritional Biochemistry and Requirements **10%**

1. Demonstrate knowledge of definitions, classifications, metabolism, functions, and interactions of the following nutrients:
    i. Carbohydrates including fiber
    ii. Lipids
    iii. Proteins and other nitrogen-containing compounds
    iv. Vitamins, vitamin-like, and other functional compounds
    v. Minerals
    vi. Water
2. Demonstrate knowledge of energy and energetics including measurement methods
3. Demonstrate knowledge of nutritional aspects of acid-base regulation
4. Demonstrate knowledge of comparative aspects of nutritional biochemistry and requirements
5. Describe the derivation and application of nutritional requirements, including but not limited to:
    i. Minimal vs. adequate vs. recommended vs. safe upper limits/maximum tolerable level vs. toxic
    ii. Allometry
6. Demonstrate knowledge of intake for an animal and its relationship to nutrient requirements, such as:
    i. Bioavailability

B. Nutritional Physiology and Pathophysiology **10%**

1. Demonstrate knowledge of physiology
    i. Alimentary/Digestive
    ii. Endocrine
    iii. Metabolic
    iv. Urinary and Renal
    v. Immunologic
    vi. Cardiorespiratory
    vii. Musculoskeletal
    viii. Neoplastic
    ix. Pancreatic
    x. Hepatic
    xi. Dermatological
    xii. Neurological/Cognitive
2. Demonstrate knowledge of nutrient-gene interactions, including but not limited to:
    i. Epigenetics
    ii. Breed differences

3. Demonstrate knowledge of age-, life stage-, sex-, breed- or species-related nutritional physiology and pathophysiology
4. Demonstrate knowledge of the prevention and pathophysiology of diet-induced and nutrient sensitive diseases
5. Demonstrate knowledge of the regulation of appetite and control of food intake
6. Demonstrate knowledge of the causes and consequences of altered body composition (e.g., cachexia, sarcopenia, obesity) and methods of assessment
7. Demonstrate knowledge of the pathophysiology of starvation and catabolic disease
8. Demonstrate knowledge of nutrient-drug interactions

C. Assessment of Individual/Group **20%**

1. Recognize age-, life stage-, sex-, breed- or species-related susceptibility to nutritional problems
2. Interpret body weight, body condition, muscle mass, and changes over time
3. Recognize physical signs and interpret laboratory results of diet-induced or nutrient sensitive conditions, including but not limited to:
    i. Imaging
    ii. Clinical pathology tests
4. Identify candidate for assisted nutritional support
    i. Enteral
    ii. Parenteral
5. Ability to evaluate status and nutritional considerations of the following life stages:
    i. Maintenance
    ii. Growth (pre-weaning and post-weaning)
    iii. Reproduction
    iv. Production/Lactation
    v. Working/Performance
6. Evaluate status and nutritional considerations for the following diseases/conditions (individually or in combination):
    i. Gastrointestinal
    ii. Endocrine
    iii. Metabolic
    iv. Urinary and Renal
    v. Cardiorespiratory
    vi. Musculoskeletal
    vii. Dental
    viii. Neoplastic
    ix. Pancreatic
    x. Hepatic

xi. Dermatological
xii. Neurological/Cognitive
xiii. Obesity
xiv. Starvation
xv. Critical illness (e.g., trauma, sepsis, peri-operative)

D. Dietary Assessment and Feeding Practice **25%**

1. Obtain accurate and complete diet/ration history, including treats, supplements, and foods for medication administration
2. Determine energy, dry matter, and nutrient intake
3. Assess adequacy of energy, dry matter, and nutrient intake relative to individual/group requirements
4. Evaluate non-nutritive feed additives and growth promotants
5. Describe nutritional implications of food/feed forms, including but not limited to:
    i. Forage forms
    ii. Commercial feed types (large animal and small animal)
    iii. Homemade
6. Assess nutritional implications of environmental factors, including but not limited to:
    i. Season/Climate
    ii. Feed competition
    iii. Stress
    iv. Enrichment
7. Develop a species appropriate plan to sample and analyze food/feed/water, including but not limited to:
    i. Nutrient content
    ii. Contaminants
    iii. Forage analysis
8. Interpret the results of food/feed/water laboratory analyses and formulation software
    i. Evaluate company provided information (e.g., feed/ingredient labels, website information, product guides)
    ii. Evaluate nutritional value of ingredients and effect of processing
9. Demonstrate knowledge of implications of and indications for specific feeding practices, including but not limited to:
    i. Frequency
    ii. Location
10. Assess relative nutritional and economic value of feeding systems, such as:
    i. Nutrition modeling
11. Recognize diet related toxicosis, including but not limited to:

i. Toxic plants
ii. Contaminants
iii. Nutrients
iv. Microbial

E. Develop a Nutritional Plan for the Individual/Group **25%**

1. Assess the animal's nutritional considerations compared to current diet/ration
2. Develop a prioritized nutritionally relevant problem list and differential diagnosis list
3. Develop a diagnostic plan and interpret results, including but not limited to:
    i. Imaging
    ii. Clinical pathologic tests
4. Demonstrate knowledge of principles of ration/recipe formulation
5. Formulate an appropriate ration/recipe to meet specific considerations, including but not limited to:
    i. Cost
    ii. Environmental sustainability,
    iii. Ingredient restrictions,
    iv. Ingredient accessibility
    v. Palatability
6. Incorporate assessment findings to develop a feeding plan (e.g., diet, treats, supplements, medications, amounts, feeding method) based on prioritization of needs
7. Establish a monitoring program for individual/group
8. Evaluate individual/group response to feeding plan and modify as needed
9. Demonstrate knowledge of nutritional and pharmacological methods to manage animals with altered appetites
10. Demonstrate knowledge of assisted feeding tube selection, placement technique, management, and potential complications, including specific dietary recommendations and fluid administration
11. Demonstrate knowledge of catheter selection, formulation, institution, and monitoring of parenteral nutrition and fluid administration
12. Describe characteristics of the components used in parenteral nutrition
13. Communicate the feeding plan to relevant parties
    i. Provide rationale for the feeding plan
    ii. Answer feeding plan questions
    iii. Utilize techniques to increase client's adherence to feeding plan or nutritional recommendations
    iv. Address misconceptions regarding nutrition, diets, and ingredients

F. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods **10%**

1. Demonstrate knowledge of principles of manufacturing and food science, including but not limited to:
    i. Processing
    ii. Quality control
    iii. Safety
    iv. Preservatives
2. Demonstrate knowledge of the role of ingredients as sources of nutrients, including but not limited to:
    i. Bioavailability
    ii. Digestibility
    iii. Storage/handling techniques
    iv. Soil quality as determined by soil testing
3. Demonstrate knowledge of sustainability and environmental implications of feeding practices
4. Demonstrate knowledge of safe storage and analysis procedures for contamination
5. Demonstrate knowledge of regulations and labeling
6. Demonstrate knowledge of food/feed analytical methods and their limitations

Section III: Essay (Small or Large Animal Specific)

A. Assessment of Individual/Group **30%**

1. Recognize age-, life stage-, sex-, breed- or species-related susceptibility to nutritional problems
2. Interpret body weight, body condition, muscle mass, and changes over time
3. Recognize physical signs and interpret laboratory results of diet-induced or nutrient sensitive conditions, including but not limited to:
    i. Imaging
    ii. Clinical pathology tests
4. Identify candidate for assisted nutritional support
    i. Enteral
    ii. Parenteral
5. Ability to evaluate status and nutritional considerations of the following life stages:
    i. Maintenance
    ii. Growth (pre-weaning and post-weaning)
    iii. Reproduction
    iv. Production/Lactation
    v. Working/Performance
6. Evaluate status and nutritional considerations for the following diseases/conditions (individually or in combination):
    i. Gastrointestinal
    ii. Endocrine
    iii. Metabolic
    iv. Urinary and Renal
    v. Cardiorespiratory
    vi. Musculoskeletal
    vii. Dental
    viii. Neoplastic
    ix. Pancreatic
    x. Hepatic
    xi. Dermatological
    xii. Neurological/Cognitive
    xiii. Obesity
    xiv. Starvation
    xv. Critical illness (e.g., trauma, sepsis, peri-operative)

B. Dietary Assessment and Feeding Practice **35%**

1. Obtain accurate and complete diet/ration history, including treats, supplements, and foods for medication administration

2. Determine energy, dry matter, and nutrient intake
3. Assess adequacy of energy, dry matter, and nutrient intake relative to individual/group requirements
4. Evaluate non-nutritive feed additives and growth promotants
5. Describe nutritional implications of food/feed forms and processing for different species, including but not limited to:
    i. Forage forms
    ii. Commercial feed types (large animal and small animal)
    iii. Homemade
6. Assess nutritional implications of environmental factors, including but not limited to:
    i. Season/Climate
    ii. Feed competition
    iii. Stress
    iv. Enrichment
7. Develop a species appropriate plan to sample and analyze food/feed/water, including but not limited to:
    i. Nutrient content
    ii. Contaminants
    iii. Forage analysis
8. Interpret the results of food/feed/water laboratory analyses and formulation software
    i. Evaluate company provided information (e.g., feed/ingredient labels, website information, product guides)
    ii. Evaluate nutritional value of ingredients and effect of processing
9. Demonstrate knowledge of implications of and indications for specific feeding practices, including but not limited to:
    i. Frequency
    ii. Location
10. Assess relative nutritional and economic value of feeding systems, such as:
    i. Nutrition modeling
11. Recognize diet related toxicosis, including but not limited to:
    i. Toxic plants
    ii. Contaminants
    iii. Nutrients
    iv. Microbial

C. Develop a Nutritional Plan for the Individual/Group **35%**

1. Assess the animal's nutritional considerations compared to current diet/ration

2. Develop a prioritized nutritionally relevant problem list and differential diagnosis list
3. Develop a diagnostic plan and interpret results, including but not limited to:
    i. Imaging
    ii. Clinical pathologic tests
4. Demonstrate knowledge of principles of ration/recipe formulation
5. Formulate an appropriate ration/recipe to meet specific considerations, including but not limited to:
    i. Cost
    ii. Environmental sustainability,
    iii. Ingredient restrictions,
    iv. Ingredient accessibility
    v. Palatability
6. Incorporate assessment findings to develop a feeding plan (e.g., diet, treats, supplements, medications, amounts, feeding method) based on prioritization of needs
7. Establish a monitoring program for individual/group
8. Evaluate individual/group response to feeding plan and modify as needed
9. Demonstrate knowledge of nutritional and pharmacological methods to manage animals with altered appetites
10. Demonstrate knowledge of assisted feeding tube selection, placement technique, management, and potential complications, including specific dietary recommendations
11. Demonstrate knowledge of catheter selection, formulation, institution, and monitoring of parenteral nutrition
12. Describe characteristics of the components used in parenteral nutrition
13. Communicate the feeding plan to relevant parties
    i. Provide rationale for the feeding plan
    ii. Answer feeding plan questions
    iii. Utilize techniques to increase client's adherence to feeding plan or nutritional recommendations
    iv. Address misconceptions regarding nutrition, diets, and ingredients

APPENDIX D: Updated Test Specifications

Section I: Multiple-Choice (Small or Large Animal Specific)

A. Nutritional Biochemistry and Requirements **30%**

1. Demonstrate knowledge of definitions, classifications, metabolism, functions, and interactions of the following nutrients:
    - i. Carbohydrates including fiber
    - ii. Lipids
    - iii. Proteins and other nitrogen-containing compounds
    - iv. Vitamins, vitamin-like, and other functional compounds
    - v. Minerals
    - vi. Water
2. Demonstrate knowledge of energy and energetics including measurement methods
3. Demonstrate knowledge of nutritional aspects of acid-base regulation
4. Demonstrate knowledge of comparative aspects of nutritional biochemistry and requirements
5. Describe the derivation and application of nutritional requirements, including but not limited to:
    - i. Minimal vs. adequate vs. recommended vs. safe upper limits/maximum tolerable level vs. toxic
    - ii. Allometry
6. Demonstrate knowledge of intake for an animal and its relationship to nutrient requirements, such as:
    - i. Bioavailability

B. Nutritional Physiology and Pathophysiology **20%**

1. Demonstrate knowledge of physiology
    - i. Alimentary/Digestive
    - ii. Endocrine
    - iii. Metabolic
    - iv. Urinary and Renal
    - v. Immunologic
    - vi. Cardiorespiratory
    - vii. Musculoskeletal
    - viii. Neoplastic
    - ix. Pancreatic
    - x. Hepatic
    - xi. Dermatological
    - xii. Neurological/Cognitive
2. Demonstrate knowledge of nutrient-gene interactions, including but not limited to:

i. Epigenetics
ii. Breed differences

3. Demonstrate knowledge of age-, life stage-, sex-, breed- or species-related nutritional physiology and pathophysiology
4. Demonstrate knowledge of the prevention and pathophysiology of diet-induced and nutrient sensitive diseases
5. Demonstrate knowledge of the regulation of appetite and control of food intake
6. Demonstrate knowledge of the causes and consequences of altered body composition (e.g., cachexia, sarcopenia, obesity) and methods of assessment
7. Demonstrate knowledge of the pathophysiology of starvation and catabolic disease
8. Demonstrate knowledge of nutrient-drug interactions

C. Assessment of Individual/Group **10%**

1. Recognize age-, life stage-, sex-, breed- or species-related susceptibility to nutritional problems
2. Interpret body weight, body condition, muscle mass, and changes over time
3. Recognize physical signs and interpret laboratory results of diet-induced or nutrient sensitive conditions, including but not limited to:
   i. Imaging
   ii. Clinical pathology tests
4. Identify candidate for assisted nutritional support
   i. Enteral
   ii. Parenteral
5. Ability to evaluate status and nutritional considerations of the following life stages:
   i. Maintenance
   ii. Growth (pre-weaning and post-weaning)
   iii. Reproduction
   iv. Production/Lactation
   v. Working/Performance
6. Evaluate status and nutritional considerations for the following diseases/conditions (individually or in combination):
   i. Gastrointestinal
   ii. Endocrine
   iii. Metabolic
   iv. Urinary and Renal
   v. Cardiorespiratory
   vi. Musculoskeletal
   vii. Dental
   viii. Neoplastic

ix. Pancreatic
x. Hepatic
xi. Dermatological
xii. Neurological/Cognitive
xiii. Obesity
xiv. Starvation
xv. Critical illness (e.g., trauma, sepsis, peri-operative)

D. Dietary Assessment and Feeding Practice **12.5%**

1. Obtain accurate and complete diet/ration history, including treats, supplements, and foods for medication administration
2. Determine energy, dry matter, and nutrient intake
3. Assess adequacy of energy, dry matter, and nutrient intake relative to individual/group requirements
4. Evaluate non-nutritive feed additives and growth promotants
5. Describe nutritional implications of food/feed forms, including but not limited to:
    i. Forage forms
    ii. Commercial feed types (large animal and small animal)
    iii. Homemade
6. Assess nutritional implications of environmental factors, including but not limited to:
    i. Season/Climate
    ii. Feed competition
    iii. Stress
    iv. Enrichment
7. Develop a species appropriate plan to sample and analyze food/feed/water, including but not limited to:
    i. Nutrient content
    ii. Contaminants
    iii. Forage analysis
8. Interpret the results of food/feed/water laboratory analyses and formulation software
    i. Evaluate company provided information (e.g., feed/ingredient labels, website information, product guides)
    ii. Evaluate nutritional value of ingredients and effect of processing
9. Demonstrate knowledge of implications of and indications for specific feeding practices, including but not limited to:
    i. Frequency
    ii. Location
10. Assess relative nutritional and economic value of feeding systems, such as:

i. Nutrition modeling

11. Recognize diet related toxicosis, including but not limited to:
    i. Toxic plants
    ii. Contaminants
    iii. Nutrients
    iv. Microbial

E. Develop a Nutritional Plan for the Individual/Group **12.5%**

1. Assess the animal's nutritional considerations compared to current diet/ration
2. Develop a prioritized nutritionally relevant problem list and differential diagnosis list
3. Develop a diagnostic plan and interpret results, including but not limited to:
    i. Imaging
    ii. Clinical pathologic tests
4. Demonstrate knowledge of principles of ration/recipe formulation
5. Formulate an appropriate ration/recipe to meet specific considerations, including but not limited to:
    i. Cost
    ii. Environmental sustainability,
    iii. Ingredient restrictions,
    iv. Ingredient accessibility
    v. Palatability
6. Incorporate assessment findings to develop a feeding plan (e.g., diet, treats, supplements, medications, amounts, feeding method) based on prioritization of needs
7. Establish a monitoring program for individual/group
8. Evaluate individual/group response to feeding plan and modify as needed
9. Demonstrate knowledge of nutritional and pharmacological methods to manage animals with altered appetites
10. Demonstrate knowledge of assisted feeding tube selection, placement technique, management, and potential complications, including specific dietary recommendations and fluid administration
11. Demonstrate knowledge of catheter selection, formulation, institution, and monitoring of parenteral nutrition and fluid administration
12. Describe characteristics of the components used in parenteral nutrition
13. Communicate the feeding plan to relevant parties
    i. Provide rationale for the feeding plan
    ii. Answer feeding plan questions
    iii. Utilize techniques to increase client's adherence to feeding plan or nutritional recommendations

iv. Address misconceptions regarding nutrition, diets, and ingredients

F. Food/Feed and Supplement Production, Safety, Regulation, and Research Methods **15%**

1. Demonstrate knowledge of principles of manufacturing and food science, including but not limited to:
    i. Processing
    ii. Quality control
    iii. Safety
    iv. Preservatives
2. Demonstrate knowledge of the role of ingredients as sources of nutrients, including but not limited to:
    i. Bioavailability
    ii. Digestibility
    iii. Storage/handling techniques
    iv. Soil quality as determined by soil testing
3. Demonstrate knowledge of sustainability and environmental implications of feeding practices
4. Demonstrate knowledge of safe storage and analysis procedures for contamination
5. Demonstrate knowledge of regulations and labeling
6. Demonstrate knowledge of food/feed analytical methods and their limitations

Section II: Essay (Small or Large Animal Specific)

A. Assessment of Individual/Group **30%**

1. Recognize age-, life stage-, sex-, breed- or species-related susceptibility to nutritional problems
2. Interpret body weight, body condition, muscle mass, and changes over time
3. Recognize physical signs and interpret laboratory results of diet-induced or nutrient sensitive conditions, including but not limited to:
    i. Imaging
    ii. Clinical pathology tests
4. Identify candidate for assisted nutritional support
    i. Enteral
    ii. Parenteral
5. Ability to evaluate status and nutritional considerations of the following life stages:
    i. Maintenance
    ii. Growth (pre-weaning and post-weaning)
    iii. Reproduction
    iv. Production/Lactation
    v. Working/Performance
6. Evaluate status and nutritional considerations for the following diseases/conditions (individually or in combination):
    i. Gastrointestinal
    ii. Endocrine
    iii. Metabolic
    iv. Urinary and Renal
    v. Cardiorespiratory
    vi. Musculoskeletal
    vii. Dental
    viii. Neoplastic
    ix. Pancreatic
    x. Hepatic
    xi. Dermatological
    xii. Neurological/Cognitive
    xiii. Obesity
    xiv. Starvation
    xv. Critical illness (e.g., trauma, sepsis, peri-operative)

B. Dietary Assessment and Feeding Practice **35%**

1. Obtain accurate and complete diet/ration history, including treats, supplements, and foods for medication administration

2. Determine energy, dry matter, and nutrient intake
3. Assess adequacy of energy, dry matter, and nutrient intake relative to individual/group requirements
4. Evaluate non-nutritive feed additives and growth promotants
5. Describe nutritional implications of food/feed forms and processing for different species, including but not limited to:
    i. Forage forms
    ii. Commercial feed types (large animal and small animal)
    iii. Homemade
6. Assess nutritional implications of environmental factors, including but not limited to:
    i. Season/Climate
    ii. Feed competition
    iii. Stress
    iv. Enrichment
7. Develop a species appropriate plan to sample and analyze food/feed/water, including but not limited to:
    i. Nutrient content
    ii. Contaminants
    iii. Forage analysis
8. Interpret the results of food/feed/water laboratory analyses and formulation software
    i. Evaluate company provided information (e.g., feed/ingredient labels, website information, product guides)
    ii. Evaluate nutritional value of ingredients and effect of processing
9. Demonstrate knowledge of implications of and indications for specific feeding practices, including but not limited to:
    i. Frequency
    ii. Location
10. Assess relative nutritional and economic value of feeding systems, such as:
    i. Nutrition modeling
11. Recognize diet related toxicosis, including but not limited to:
    i. Toxic plants
    ii. Contaminants
    iii. Nutrients
    iv. Microbial

C. Develop a Nutritional Plan for the Individual/Group **35%**

1. Assess the animal's nutritional considerations compared to current diet/ration

2. Develop a prioritized nutritionally relevant problem list and differential diagnosis list
3. Develop a diagnostic plan and interpret results, including but not limited to:
    i. Imaging
    ii. Clinical pathologic tests
4. Demonstrate knowledge of principles of ration/recipe formulation
5. Formulate an appropriate ration/recipe to meet specific considerations, including but not limited to:
    i. Cost
    ii. Environmental sustainability,
    iii. Ingredient restrictions,
    iv. Ingredient accessibility
    v. Palatability
6. Incorporate assessment findings to develop a feeding plan (e.g., diet, treats, supplements, medications, amounts, feeding method) based on prioritization of needs
7. Establish a monitoring program for individual/group
8. Evaluate individual/group response to feeding plan and modify as needed
9. Demonstrate knowledge of nutritional and pharmacological methods to manage animals with altered appetites
10. Demonstrate knowledge of assisted feeding tube selection, placement technique, management, and potential complications, including specific dietary recommendations
11. Demonstrate knowledge of catheter selection, formulation, institution, and monitoring of parenteral nutrition
12. Describe characteristics of the components used in parenteral nutrition
13. Communicate the feeding plan to relevant parties
    i. Provide rationale for the feeding plan
    ii. Answer feeding plan questions
    iii. Utilize techniques to increase client's adherence to feeding plan or nutritional recommendations
    iv. Address misconceptions regarding nutrition, diets, and ingredients