American College of Veterinary Internal Medicine (ACVIM)
Oncology Specialty Exam (ONCO)
Test Specifications

I. Principles of Cancer Biology	22%
A. Cancer Genome	
1. Describe normal DNA replication and protein synthesis (e.g., chromosome structure, DNA transcription and binding domains, RNA transcription and translation)	
2. Describe common DNA mutations and discuss how these relate to oncogenesis and cancer treatment	
3. Define aneuploidy and its significance in cancer	
4. Discuss proto-oncogenes, their normal function, their role in carcinogenesis, and list key examples	
5. Discuss tumor suppressor genes, their normal function, their role in carcinogenesis, and list key examples	
6. Define single nucleotide polymorphisms and copy number variations and recognize their significance in cancer	
B. Genomic Instability	
1. Identify chromosomal translocation, deletion, insertion, inversion, single strand breaks, double strand breaks and their significance in cancer	
2. Identify internal tandem duplication, its significance in cancer, and list key examples	
3. Recognize the significance of somatic and germline mutations and list key examples	
4. Define microsatellite instability and its significance in cancer	
5. Describe mismatch repair, nucleotide excision repair, and base excision repair, and the role of deficiencies in repair processes in cancer	
C. Epigenetics	
1. Define histone modification and implications for tumorigenesis and therapy (e.g., methylation, acetylation)	
2. Define gene silencing/activation and implications for tumorigenesis and therapy (e.g., methylation, acetylation)	
3. Recognize extra-chromosomal elements and their impact on DNA and RNA expression (e.g., complimentary DNA, long non-coding RNA, RNA interference, silencing RNAs)	
D. Cellular Senescence & Immortalization	
1. Describe the structure and function of a telomere	
2. Define cellular senescence and the role of telomerase and alternate lengthening of telomeres (ALT)	

3. Recognize the role of telomeres in tumorigenesis and implications for therapy
E. Cell Cycle
1. Describe the phases of the cell cycle
2. Recognize:
a. cell cycle checkpoints
b. mechanisms of regulation of cell cycle transitions
3. Discuss cell cycle regulators and mechanisms of dysregulation
4. Identify methods to determine cell cycle phase and growth fraction (e.g., flow cytometry, mitotic count)
F. Growth Factors, Receptors & Cell Signaling
1. Outline growth factors, their target receptors, and their significance in cancer
2. Describe kinases and the role of phosphorylation/dephosphorylation in cell signaling
3. Outline signaling pathways and their significance in cancer (e.g., JAK/STAT, MAPK (Ras-Raf-MEK), TGF-ß, Wnt)
4. Define endocrine, autocrine, and paracrine signaling
G. Cell Death
1. Describe the mechanisms of cell death and the pathways that regulate them (e.g., apoptosis, autophagy, ferroptosis, necrosis)
2. Describe cell survival pathways
3. Outline the pathways that regulate apoptosis and mechanisms of dysregulation
H. Cancer Metabolism
1. Describe altered metabolic pathways in cancer (e.g., hypoxic pathways, Warburg Effect)
2. Describe the clinical tools for studying cancer metabolism (e.g., FDG/PET imaging, metabolic assays)
I. Angiogenesis
1. Outline the sequential steps involved in angiogenesis
2. List the intrinsic molecular mediators and inhibitors of angiogenesis
3. Recognize triggers that drive angiogenesis
4. Describe the difference between angiogenesis and neo-angiogenesis
J. Invasion & Metastasis
1. List the steps in the metastatic cascade
2. Describe the selective pressures for metastasis
3. Describe the principles of epithelial-to-mesenchymal transition and vice versa
4. Contrast the seed and soil hypothesis vs. hemodynamic pattern of metastasis
5. List metastasis associated genes

K. Tumor Microenvironments
1. Describe the normal interaction between a cell and its microenvironment
2. Discuss the role that cellular adhesion molecules play in a normal state and how these can be altered in cancer progression
3. Describe the process of cellular migration
4. Describe drivers of cellular migration (e.g., hypoxia, inflammation, pH)
5. Discuss the role of proteolytic enzymes and their inhibitors in the tumor microenvironment
L. Tumor Immunology
1. Summarize the immune response to tumors
2. Identify the immune cell types and their role within tumor (e.g., tumor infiltrating leukocytes, T-Reg)
3. Recognize the role of molecular markers in identifying cell types (e.g., CDs, FoxP3)
4. Recognize the mechanisms by which tumors evade the immune system
5. Recognize the mechanisms by which tumors modulate the immune system (e.g., anergy, tolerance)
6. Describe the development of antigen specificity in lymphocytes
M. Cancer Stem Cells
1. Describe cancer stem cell theory
2. Describe the features of cancer stem cells (e.g., diagnostic markers, metabolic properties, role in treatment resistance)
3. Describe the role of tumor heterogeneity in tumor growth and response
4. Discuss the role of cancer stem cells in tumor resistance
N. Carcinogenesis
1. Describe initiation, promotion, and progression of neoplasia
2. Recognize types of carcinogens and mechanisms of carcinogenesis (including known specific tumor type risk factors)
a. Chemical
b. Hormonal
c. Physical
d. Viral
3. Discuss the role of inflammation in the promotion of cancer
4. Recognize inherited susceptibilities that allow for the development of cancer (e.g., BRCA 1 & 2)
II. Research Principles **10%**

1. Evaluate clinical trials, study design, and statistics
a. Define the advantages and limitations of different study designs (e.g., cohort, observational, prospective, retrospective, randomized)
b. Evaluate the design and interpret the results of phase 0 – IV clinical trials
c. Identify the components of trials conducted under good clinical practice (GCP) standards
d. Interpret statistical analyses (e.g., Kaplan-Meier, multivariable, ROC curves, confidence interval)
e. Analyze study methods for biases, strengths and weaknesses in power, and statistical conclusions
2. Explain test methodologies and analyze results, utility, and limitations (e.g., cell death assays, flow cytometry, next generation sequencing, PCR/RT-PCR, western blotting)
3. Interpret data from pharmacokinetic, pharmacogenetic, and pharmacodynamic analyses
4. Interpret genome-wide association studies in relation to our understanding of cancer in specific breeds
III. Tumor Behavior, Diagnostics & Prognostic Indicators **25%**
1. Apply significant findings from a physical exam to establish a differential diagnosis list and diagnostic recommendations
2. Choose diagnostic tests to evaluate for non-neoplastic differentials (e.g., infectious disease, endocrine)
3. Describe grading schemes for a given histologic tumor type
4. Describe staging schemes for a given histologic tumor type
5. Interpret results of a provided cytology report or image and advise on next steps
6. Interpret results of a provided histology report and advise on next steps
7. Summarize available literature regarding biologic behavior for a given histologic tumor type (e.g., metastatic rate/pattern, time to progression)
8. Describe the pathophysiology and incidence of paraneoplastic syndromes
9. Identify clinical, cytologic, histopathologic, and molecular prognostic factors for a given tumor type
10. Apply the results of diagnostic tests toward the clinical management of cancer patients
a. Interpret hematological, biochemical, urinalysis, and culture results
b. Compare utility of flow cytometry, PARR, IHC, ICC, and histology
c. Recommend histologic stains and/or markers to define a specific tumor type or prognosis
d. Discuss the role of molecular testing (e.g., tumor profiling, liquid biopsy) in cancer case management
e. Interpret discordant test results in a given scenario
11. Evaluate potential risks & limitations associated w/ sampling of specific anatomic sites & tumor types (e.g., thoracocentesis, nasal biopsy, bone biopsy)
12. Evaluate diagnostic imaging tests and interpret results
a. Describe the technology used and interpret images in various modalities (e.g., CT, MRI, PET, radiographs, scintigraphy, ultrasound)

b. Compare indications for and limitations of specific imaging techniques
IV. Cancer Treatment Modalities **25%**
A. Surgical Oncology
1. Describe indications for excisional vs. incisional biopsy
2. Describe the recommended margin for specific histologic tumor types and location
3. Weigh patient-specific factors that impact surgical dose recommendations
4. Explain how post-surgical factors influence margin measurement
5. Describe sentinel lymph node mapping techniques and indications
6. Discuss how patient comorbidities, imaging results, and anatomic and histopathology features can influence surgical planning and outcome for a given tumor histology
7. Discuss risks, benefits, and outcomes of minimally invasive surgery techniques (e.g., microwave ablation, video-assisted surgery)
8. Cite published outcomes of surgery (e.g., AE, DFI, PFI, MST) for a specific tumor type
B. Radiation Oncology
1. Describe the effects of ionizing radiation on neoplastic and normal tissues
2. List the five Rs of radiation and their effect on treatment planning and outcome
3. Cite published outcomes of radiation therapy (e.g., DFI, PFI, response rate) for specific tumor types
4. Define gross tumor volume, clinical target volume, planning target volume, and radiation dosing unit
5. Define acute and late responding tissues and the impact on response and toxicity (e.g., α/β ratio)
6. Apply VRTOG criteria in the evaluation of a patient
7. Discuss the pros and cons of radiosensitizers and list agents
8. Compare stereotactic body radiation therapy, intensity modulated radiation therapy, tomotherapy, plesiotherapy, brachytherapy, and electron therapy
9. Assess the treatment plan (e.g., dose volume histogram, contouring, dose color wash) and explain implications on normal and tumor tissue, recurrence, and morbidity
10. Discuss the goals, indications, and toxicity of different radiation protocols (e.g., accelerated, coarse fractionated, definitive, palliative radiation, SRT, re-irradiation)
11. Weigh patient-specific factors that impact radiation recommendations
12. Discuss the use of radiopharmaceuticals in cancer management (e.g., I-131 and Sm-153)
C. Interventional & Other Local Therapies
1. Discuss mechanism, indications, and toxicity of electrochemotherapy for various tumor types
2. Discuss indications, outcome, and complications of stent placement for various tumor locations

3. Discuss mechanism, indications, outcome, and complications of intervention radiology procedures for various tumor types (e.g., embolization, ethanol ablation)
4. Discuss mechanism, indications, outcome, and toxicity of intralesional treatment for various tumor types (e.g., chemotherapy impregnated beads, tigilanol tiglate, chemotherapy)
5. Evaluate literature for use of additional local therapies (e.g., cryotherapy, hyperthermia, inhalational, photodynamic therapy, laser ablation)
D. Immunotherapy
1. Define the types of immunotherapy (e.g., active, passive, specific, nonspecific) and list examples
2. Describe the potential advantages of immunotherapy
3. Describe the limitations of immunotherapy
4. Discuss the principles of target, tumor type, and tumor burden when considering immunotherapy
5. Discuss the advantages, disadvantages, indications, outcomes, and potential treatment of Aes of the following immunotherapeutic strategies:
a. Anti-tumor vaccines
i. Allogeneic
ii. Autologous
iii. Xenogeneic
b. Cytokines
c. Immune check-point inhibitors
d. Monoclonal antibodies
e. Bispecific antibodies (e.g., bacterial, chemotherapy, and cytokine conjugates)
f. Oncolytic viruses
g. Immune cellular therapeutics (e.g., adoptive T-cells, CAR-T)
h. Non-specific immune stimulants (e.g., bacterial cell wall products, imiquimod)
E. Molecular/Targeted Therapeutics
1. Interpret a molecular profile and identify potential targeted therapies
2. Evaluate mechanisms of action, target, resistance, and toxicities for targeted therapies
3. Apply available literature addressing targeted therapies
F. Chemotherapy Principles
1. Explain the theory of body surface area formulas and their utility and limitations
2. Explain the cell kill hypothesis in relation to chemotherapy
3. Explain the Goldie-Coldman hypothesis
4. Explain the Gompertzian growth model
5. Explain the principles of maximal tolerated dose, dose intensity, and dose density
6. Explain the mechanism of metronomic chemotherapy dosing

7. Explain the mechanisms of action for a given cytotoxic agent
8. Explain the mechanisms of resistance for a given cytotoxic agent
9. Outline the pathways responsible for metabolism for a given cytotoxic agent
10. Describe the impact of each of the following as they relate to a given cytotoxic agent
a. pharmacokinetics
b. pharmacodynamics
c. pharmacogenomics (e.g., ABCB1 mutations, cytochrome p450)
11. Explain the toxicity profile for a given cytotoxic agent
12. Discuss beneficial and detrimental interactions between cytotoxic agents (e.g., carboplatin/gemcitabine, L-asparaginase/vincristine)
13. Discuss chemoprotectants (e.g., dexrazoxane, vitamin B6, MESNA, Tavocept)
14. Describe biosafety considerations when handling cytotoxic agents and oncology patients (e.g., closed systems, PPE, metabolites)
G. Chemotherapy Practice
1. Calculate appropriate dose and indicate route of administration for a given cytotoxic agent (e.g., canine, feline, equine)
2. Describe dose modifications when combining cytotoxic and/or targeted agents
3. Describe dose or protocol modifications based on patient comorbidities
4. Recommend chemotherapy dose, interval, and protocol adjustments based on dose-limiting toxicity
5. Describe response rate for given cytotoxic agent/protocol and given tumor characteristics (e.g., DFI, PFI, MST, OST)
6. Describe and compare available rescue protocols and their efficacy for a given tumor type
H. Bone Marrow Transplant Protocols
1. Discuss indications, risks, limitations, and outcomes for bone marrow transplant protocols
2. Describe the types of bone marrow transplant (e.g., allogeneic, autologous)
I. Integrative Medicine and Nutrition
1. Analyze current literature for evidence of efficacy of nutraceuticals (e.g., mushroom-derived products, sulforaphanes, Yunnan Baiyao, hepato-rotectants, herbal supplements)
2. Analyze current literature for evidence of efficacy on alternative therapies (e.g., acupuncture, laser, physical therapy)
3. Analyze current literature for evidence on efficacy on nutritional therapies
V. Management of Oncology Patients **18%**
A. Evaluation & Monitoring of Cancer Patients

1. Make a list of differential diagnoses and a diagnostic plan based on history and physical exam findings
2. Apply the following tools:
a. Pain scales
b. Quality of life / performance scales
c. RECIST/iRECIST criteria
d. Tumor volume calculation
e. VCOG response evaluation criteria for peripheral nodal lymphoma
f. WHO criteria for solid tumor response
g. VCOG-CTCAE criteria for toxicity
h. VRTOG radiation criteria for toxicity
B. Supportive Care
1. Describe principles of palliative and hospice care
2. Describe principles of appropriate antimicrobial stewardship in the care of cancer patients
3. Discuss the mechanisms of action, indications, and toxicity of
a. aminobisphosphonates
b. antidiarrheals, antiemetics, appetite stimulants, and gastroprotectants
c. anxiolytics, antidepressants, and sedatives
d. corticosteroids
e. hematopoietic growth factors
f. blood products
g. multimodal analgesia
h. NSAIDs
i. Supplements and vitamins
C. Paraneoplastic Syndromes
1. Discuss the management of patients with paraneoplastic syndromes
D. Complications of Cytotoxic Drug Administration
1. Describe the management of extravasation events
a. List irritants vs. vesicants
b. Apply appropriate treatment strategies for a given drug extravasation
c. Describe anticipated sequalae for a given drug extravasation
2. Describe the management of inappropriate dose administration
a. Apply appropriate treatment strategies for a given drug overdose (e.g., hematopoietic growth factors, prophylactic antibiotic therapy, plasmapheresis)
b. Describe anticipated sequalae for a given drug overdose

3. Describe the management of anaphylactic reactions secondary to antineoplastic agents
4. Describe the mechanism, diagnosis, and management of acute tumor lysis syndrome