NROSCI/BIOSC 1070 and MSNBIO 2070
Exam # 3
November 17, 2017

Total POINTS: 100	20% of grade in class

1)   Draw a rough sketch of a nephron *(2 points)*.

Then, for each major segment of the nephron, note the Na^+ concentration and the approximate percent of the filtered load of Na^+ that remains in that segment *(8 points)*.

2) Drugs the block aldosterone receptors in the nephron and drugs that block the Na^+-K^+-$2Cl^-$ transporter in the nephron are diuretics.

a) Explain how each of these drugs acts to produce diuresis. *(5 points)*.

b) Which of the two drugs would provide a larger diuresis? Why? *(5 points).*

3) A mutation in nephrin was found to markedly increase filtration fraction.

a) Explain the mechanism through which a nephrin mutation could increase filtration fraction. *(5 points).*

b) What tests could be run in a renal clinic to confirm your predicted mechanism? *(5 points).*

4)   *a)* What is nephrogenic diabetes insipidus? *(2 points).*

b) If a patient with diabetes insipidus were deprived of water for a day, what would happen to each of the following and how would that differ from an individual with normal renal function?   *(2 points each/8 points total).*

Urine volume:

Urine osmolarity:

Plasma volume:

Plasma osmolarity:

5) Compare and contrast the renal handling of glucose in a person with normal blood glucose levels, a person with a blood glucose concentration about twice the normal level, and a person with a blood glucose concentration about 5X the normal level. *(8 points)*.

b) Some drugs used in the treatment of diabetes mellitus partially interfere with glucose transport in the proximal tubule. How would such a drug impact your answer in part A? *(2 points)*.

6) Briefly (1-2 sentences) define each of the following immunological terms. (**2 points each).**

a) Recombination activating gene 1 (RAG1):
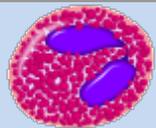
b) Anergy*:*

c) Alarmin:

d) Defensin:

7) The following table is partially completed, showing the sources and effects of three cytokines. Complete the table by filling-in the 5 unshaded boxes *(1 point each; 5 points total)*.

Cytokine	Sources	Effect on: T cells	APC	Stromal Cells	Deficiency Results in
IL-10	Th2 cells and Treg	Inhibits T cell responses	Limits their stimulatory capacity	X	Autoimmunity
Interferon-γ (IFN γ)			Increased CD80-CD86; MHCI and II	Increased MHC I; Antiviral functions	
IL-4, -5, -13		Inhibits Th1 or Type 1 T helper responses	X	Mucus production; tissue repair	

8) The following table is partially completed. Complete the table by filling-in the 5 unshaded boxes *(1 points each; 6 points total)*.

Cell Name	Schematic Representation	% of PBMC	Pathogen Targeted	Granules Phenotype after H + E staining	Name *Two* effector mechanisms used
		60%		Some fine, faintly pink granules	
		2%		Full of large pink-orange granules	

9) Three signals are needed to activate a CD4$^+$ T cell to carry out its effector functions against extracellular bacteria.

    a) List these three signals. **(6 points).**
<u>Signal 1</u>:

<u>Signal 2</u>:

<u>Signal 3</u>:

    b) Briefly explain how antigen-presenting cells (APC) are critical for the delivery of these three signals. **(3 points).**

10) Pathogens have evolved mechanisms to avoid detection by the adaptive immune system.

a) Epstein Barr virus (EBV) infects B cells and encodes a protein (EBNA1) that prevents the proteasome from breaking down cytosolic peptides. Why would this limit detection of virally infected B cells by cytotoxic T lymphocytes? *(4 points)*

b) NK cells are another other group of lymphocytes that could aid in the detection of EBV-infected cells if cytotoxic T lymphocyte recognition was hindered. What set of innate receptors would NK cells use to recognize virally infected cells, and what effector molecules would be utilized? *(4 points).*

11) You receive a grant from the World Health Organization to generate a vaccine against the Zika virus (ZIKV). This virus is thought to cause birth defects in children exposed to ZIKV in utero.

a) An effective vaccine will need to generate potent a humoral response consisting of antibodies able to both neutralize ZIKV, and also be able to transported across the placenta. What antibody isotype meets these requirements? *(1 point).*

b) You make a vaccine that consists of inactivated ZIKV and alum as a preservative. You give your first group of test subjects two injections separated by 30 days and then measure circulating antibodies in the blood thirty days later. The blood from every patient shows high levels of ZIKV-specific IgG, IgE and IgA. Based on this information, did your vaccine induce a Th1 or Th2 response? *(1 point).*

c) What cytokines would the responding subset of T cells make to support the generation of IgE and IgA? *(2 points).*

d) At what physical location would you expect to significant levels of IgA to be present? *(2 points).*

12) Transplant recipients require life-long immunosuppression, which blocks the function of CD8$^+$ T cells. Considering the typical functions of CD8$^+$ T cells in the body, explain why transplant recipients are at higher risk for developing cancer than the general population. *(8 points).*

Please Take This Page With You As A Record of Your Exam #

Exam # 3
November 17, 2017

Please Print Your Name Below
This page will be filed away until exam grading is
complete.

_____
Print Your Name

| **Exam # 3** |
| **November 17, 2017** |