



**KEEP  
CALM  
AND  
REMEMBER  
TO BREATHE**

# **ANATOMY AND PHYSIOLOGY**

**University of Michigan Invitational 2018**

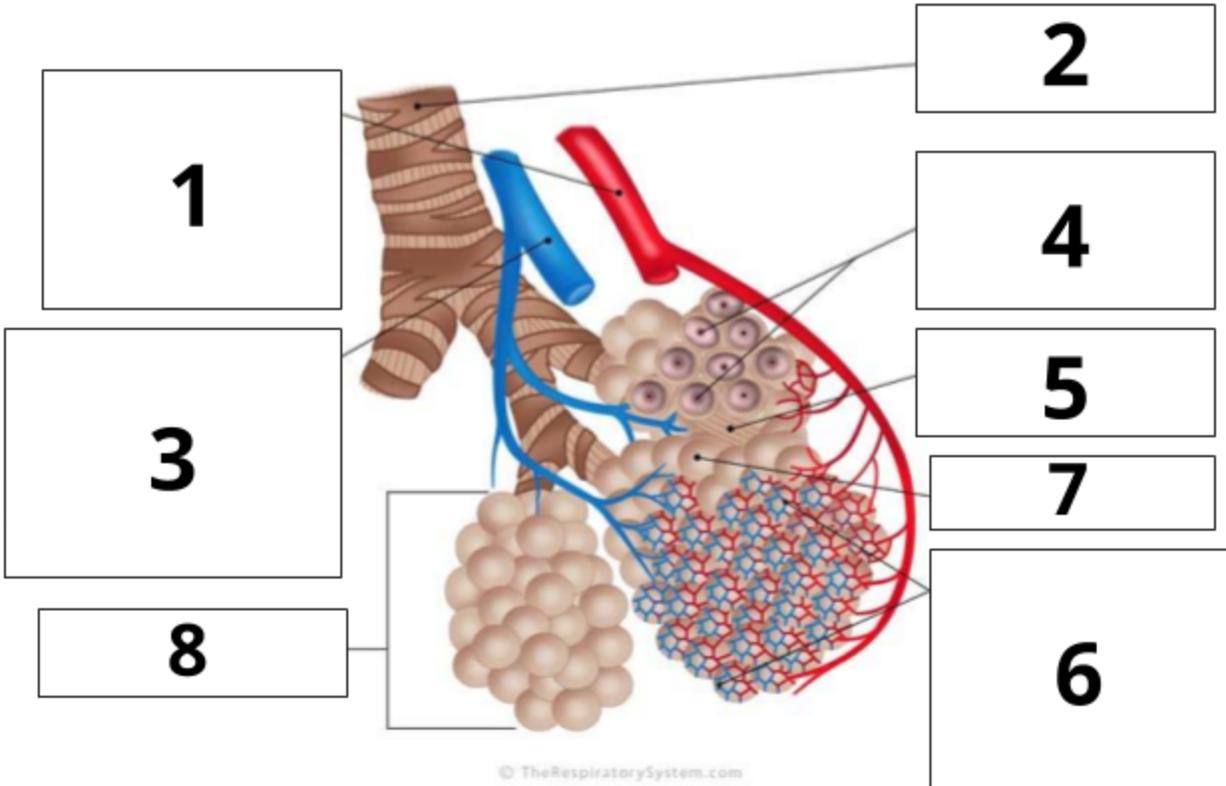
# **STATIONS**

**(This cover page does not need to be printed for competition day. The only plausible purpose it serves is so that anyone viewing the electronic copy that does not wish to see the first station upon opening the document won't have to see it.)**

**\*\*THESE STATIONS ARE 3 MINS APIECE. HERE IS THE ONLINE TIMER USED ON COMPETITION DAY: <http://www.intervaltimer.com/timers/7854217-custom-timer> \*\***

# Station 1

Label the following parts of the alveoli.



BONUS:

What is gelotology?

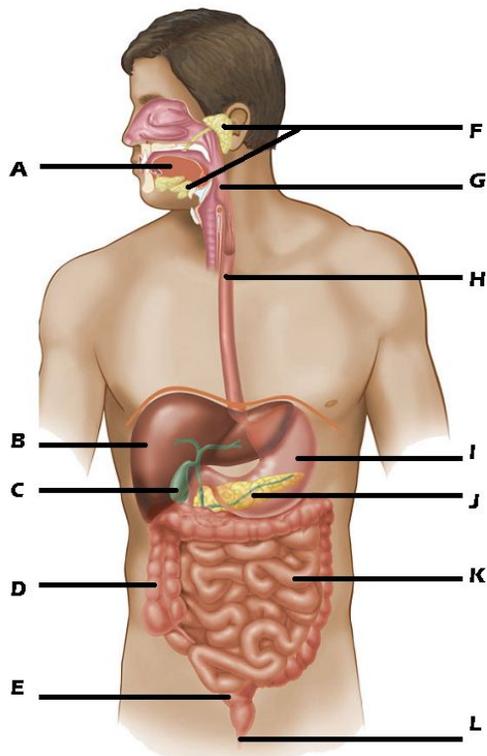
# Station 2

1. List each of the four layers of the GI tract in order of innermost to outermost layer. For each layer, describe the components of each layer and its function.
2. Identify the organ below and label each component.



3. Indicate the letters in the picture below that correspond to organs that are NOT a part of the alimentary canal and provide the name of each of those organs.

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# Station 3

1. What are the classifications of digestive enzymes and why are they classified as such?
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For each digestive enzyme, identify its organ of origin, and function.

2. Trypsin
  3. Pepsin
  4. Lysozyme
  5. Maltase
- 

6. Define *defecation* and explain how it relates to mechanical digestion
7. Which carbohydrates are digestible, where does their digestion begin, and where are they absorbed?

# Station 4

Read the following case study and answer the questions.

You are conducting an autopsy of Jackson, a 60 year old caucasian male who has worked on a peanut farm since he was a boy. His medical history indicates a history of heavy drinking and type 2 diabetes. You notice discoloration in his skin and eyes and discover bruises on his skin as well as fluid in his abdominal cavity. When you see his liver, it is obvious that his death was caused by liver failure.

1. Based on the image, what has happened to Jackson's liver?



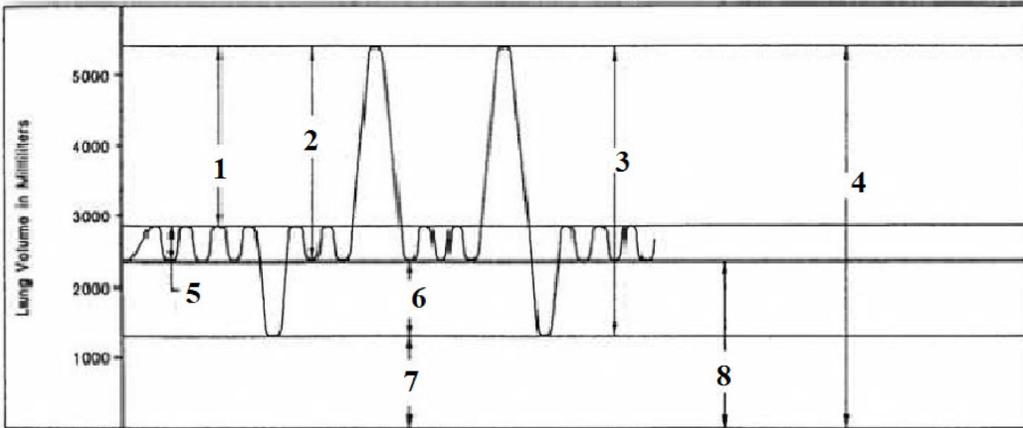
2. Given the information and the image, what type of liver disorder did Jackson most likely have?
3. What risk factors did Jackson have of this disorder?
4. What other liver related disorder increases the likelihood of this situation?

# Station 5

1. Sketch myoglobin saturation in comparison to hemoglobin saturation on an oxygen dissociation curve. Make sure to label both curves and axes.
2. List three different factors that cause shifts in the oxygen dissociation curve. Specify what affects the direction of the shift.
3. During a normal inhalation, the intrapleural pressure is about \_\_\_\_\_ mm Hg.
4. Increase in the partial pressure of carbon dioxide in the arterial blood results in \_\_\_\_\_?
5. How is carbon dioxide carried through the bloodstream?

# Station 6

Label the spirometry graph



9. A patient has a respiration rate of 15 breaths per minute and a tidal volume of 500 mL of air. Calculate the respiratory minute volume. Express your answer in L/min
10. If a patient has a vital capacity is 4500 mL, an expiratory reserve of 1250mL, and an inspiratory reserve of 2500 mL, calculate the tidal volume in liters.

# Station 7

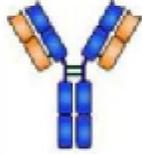
Use the list of symptoms to answer questions 1 to 5.

Salty sweat, cough that produces sputum; frequent lung infections; intestinal blockage

1. What disorder is described by the list above?
2. Describe on a cellular level what happens in the body that causes this disorder. (Hint: what cellular function is affected?)
3. Who is more likely to be affected by this disorder?
4. How is this disorder diagnosed?
5. Discuss possible cures and treatment methods and the average lifespan of someone with this disorder.

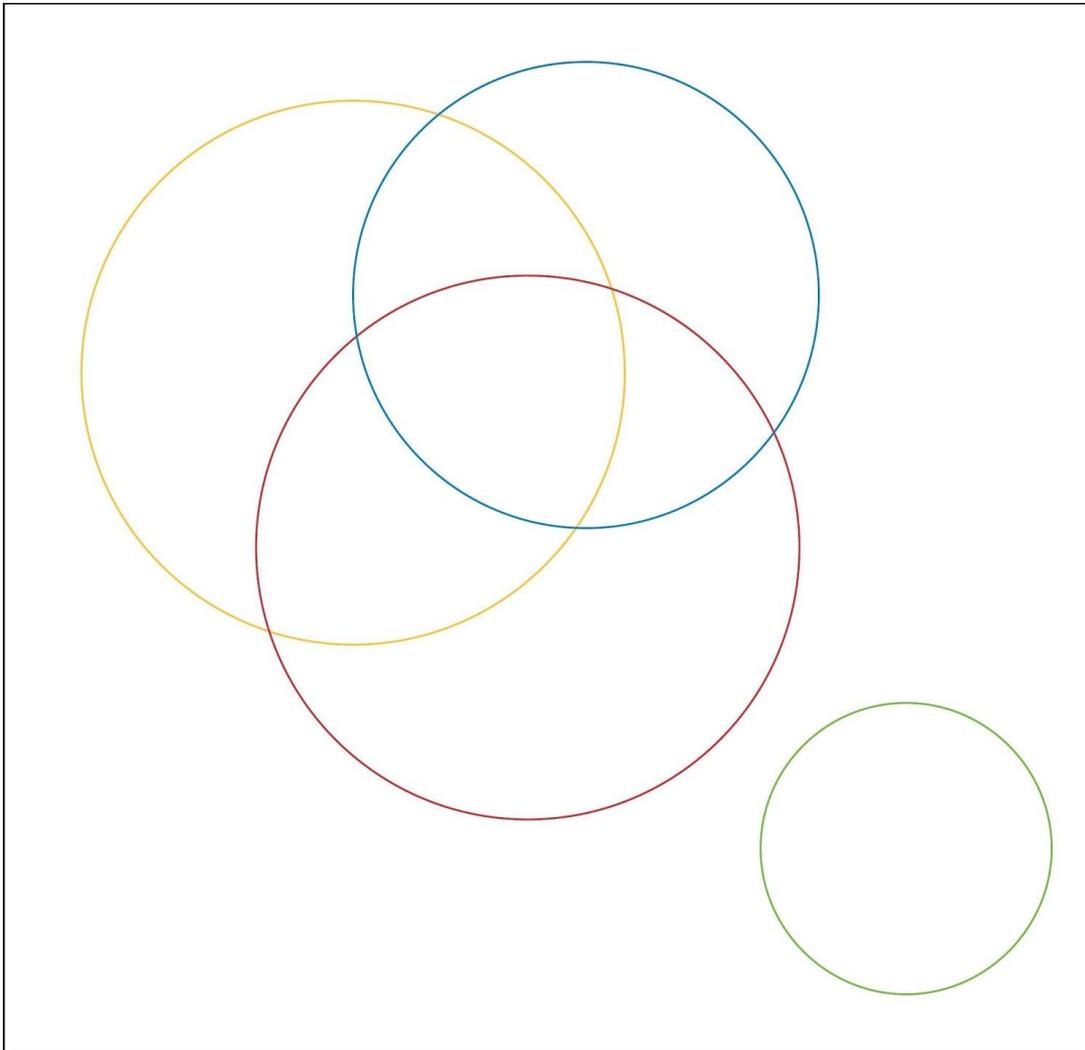
# Station 8

Fill in the following table.

<b>Structure</b>	<b>1</b>				<b>2</b>
	<b>3</b>	<b>4</b>	<b>5</b>	IgE	IgD
<b>Heavy Chain</b>	$\mu$ (mu)	<b>6</b>	$\alpha$ (alpha)	<b>7</b>	<b>8</b>
<b>Function</b>	Primary response, fixes complement. Monomer serves as B-cell receptor	Main blood antibody, neutralizes toxins, opsonization	<b>9</b>	<b>10</b>	<b>11</b>

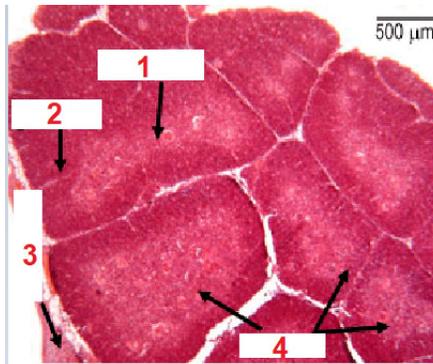
# Station 9

The following Venn diagram (including the large rectangle encompassing the circles) can be labeled to represent the relationships between the lung capacities and volumes. Do that, and also provide a brief definition for each term you write on the diagram. *Hint: The sizes of the shapes matter. The colors of the shapes may also matter.*



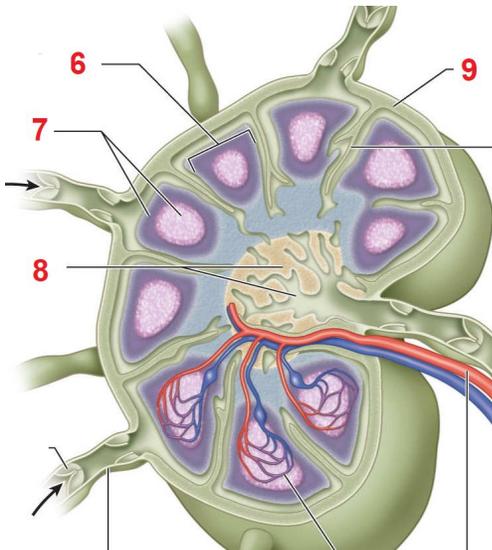
# Station 10

The following is a photomicrograph of the thymus. Label each box



5. How is the thymus related to immune function?

Label the following lymph node



10. What important cells are found in lymph nodes?

# Station 11

Identify the immune disorder related to the description.

1. Women who are or have been pregnant recently are at higher risk of developing this autoimmune disorder.
2. The anti-citrullinated protein antibody is present and is heavily associated with this disorder.
3. Skin develops a burning rash when irritants are exposed to sunlight
4. Experts recognize 4 courses of this chronic disease: progressive-relapsing, secondary progressive, primary progressive, and relapsing-remitting.
5. A common course of treatment for this disorder are antiretrovirals and nucleoside reverse transcriptase inhibitors.

# Station 12

“For almost every antigen you may encounter ... ”

Determine if each of the following statements to complete the statement above will make it true or false.

1. ... a subset of dendritic cells will be the ones to start the process of starting the immune response.
2. ... a subset of B-cells already exists in your body specific to it.
3. ... a subset of phagocytes already exists in your body that attacks only that antigen.
4. ... a subset of helper T cells already exists in your body that expresses a T-cell receptor specific to it.
5. ... a subset of antigen-specific antibodies that already exists in large numbers.
6. ... a subset of antigen-specific memory cells can be produced upon exposure to that antigen.
7. ... a subset of macrophages will be able to signal cytokines that will activate NK cells to release apoptosis-causing enzymes on cells with that antigen.

# Station 13

Stomach emptying is determined by the strength of antral peristaltic contractions and the resistance offered by the pyloric sphincter. The time taken to empty half the stomach contents was measured in one patient and compared with normal data.

Individual	Time taken for stomach to empty half its contents (min)	
	Liquid	Solid
Normal	< 20	< 120
Patient	15	180

Indicate each of the following as true or false.

1. The patient has a higher risk of malnutrition as compared to healthy individual.
2. The patient is likely to experience an increase in acid reflux.
3. The patient has a high pyloric sphincter resistance.
4. An increase in pyloric sphincter resistance will accelerate the emptying of solids from the stomach.
5. An increase in antral peristaltic contractions without an increase in pyloric sphincter resistance will accelerate the emptying of both liquids and solids from the stomach.
6. If the patient vomits, then the vomited material will contain bile.
7. Taking antacids would not help improve the patient's condition.

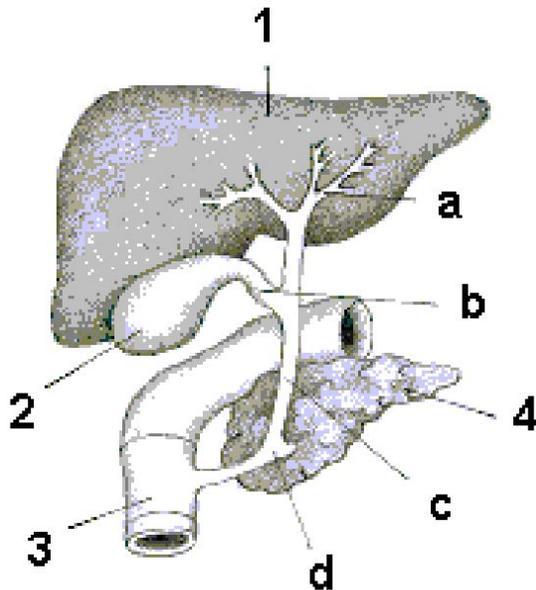
# Station 14

Jonny has been having trouble practicing piano recently. It started a couple weeks ago when he had some trouble playing “Wedding Day at Troldhaugen” by Grieg, a piece that he was planning to play for a recital in a couple months. He felt that some of his fingers were stiffer than normal, cracked his knuckles, and continued practicing anyways. Over time, the stiffness wouldn’t go away, and some pain was also building up. Suddenly one morning, he rushed to the hospital ER, complaining of the pain in his wrists and fingers being too excruciating to even attempt his daily morning piano practice of the piece. The areas where he felt pain were very big, red, and warm and tender to touch. A blood sample was taken, and it showed a low erythrocyte count with a high sedimentation rate and high levels of abnormal antibodies.

1. What does Jonny most likely have?
2. What is happening inside the body at the areas where the pain is?
3. Would a neutrophil count in blood from his wrists be normal, high, or low? Why is this so?
4. Can Jonny ever possibly be cured of his condition?
5. Name one possible method of long-term treatment for this condition.
6. Jonny still wants to perform the piece at his recital, which is now about a month away. What would you recommend him to do if he still wants to perform and you’re allowing for that to happen?

# Station 15

Use the following diagram to answer the questions:



1. Of organs 1 through 4 (NOT a through d!), which one(s) do cholecystikinin (CCK) act on? Select all that apply.

1 / 2 / 3 / 4

2. Identify structure C.
3. Organ 4 secretes which of the following enzymes? Select all that apply.

Nucleases / Lipase / Pepsin / Trypsin / Lactase / Chymotrypsin

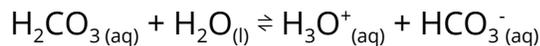
4. Organ 1 synthesizes which of the following proteins? Select all that apply.

Albumin / Fibrinogen / Transferrin / Angiotensin

5. Which labeled structure also plays an important role in the endocrine system? (Use 1-4 or a-d, not the name of the structure)
6. What are two possible digestive complications that can be caused by removal of organ 2?
7. However, even if organ 2 is removed, the patient can still live. Why is this so?

# Station 16

The principle buffer system in human blood involves the weak acid, carbonic acid ( $\text{H}_2\text{CO}_3$ ), and its conjugate base, bicarbonate ion ( $\text{HCO}_3^-$ ),



An equilibrium between carbonic acid, carbon dioxide and water is also established,



Humans unaccustomed to high altitudes tend to breathe much more rapidly (at least initially).

1. Why does this occur?
2. Will rapid breathing at high altitudes tend to produce blood acidosis or blood alkalosis? Explain your reasoning.

For a long time, many explorers who tried to climb to the top of Mount Everest died trying to get there.

3. Those who might try to climb mountains like Everest may develop "altitude sickness" after reaching a certain elevation. What occurs inside the body when altitude sickness sets in?
4. Name three symptoms altitude sickness can cause.
5. What do explorers who climb Mount Everest now do to avoid death from altitude sickness?
6. BONUS: Who were the first people to reach the top of Mount Everest using the method being asked about in #5, and in what year did they accomplish this?

# Station 17

1. Describe what happens inside the body during an allergic reaction.
  2. What is the difference between an allergy and an intolerance?
- 

The symptoms that allergies can cause can vary greatly in severity, i.e. only causing minor itching vs. causing anaphylactic shock.

3. What is one possible reason why symptoms may vary so much from person to person?
- 

Also, for some people, allergic reactions will only occur if they have enough contact with the allergen, such as ingesting it, but in others, even slightly touching or smelling it can invoke a response.

4. What is one possible reason why is it actually very difficult to estimate minimal eliciting doses for allergens?
- 

5. Name a treatment used against an allergic reaction and describe how it works to lessen or stop the response.

