**Bio Exam Study Guide: This guide is divided into 3 parts so that you can space out how you study! I plan to have a brief Question and answer for each part Tues-Friday of next week. There will NOT be enough class time to do this without working at HOME. You should consider starting this weekend!**

**Part One**

Your friend George was bored one day so he decided to read the newspaper.  In the paper, he saw an ad by Sprite Inc. asking for taste testers of their soda.  The company has branches all over the United States and they want to know if all the branches are producing soda of equal quality.  In desperate need of money, George decides to take the job.  George’s job is very simple, he must drink Sprite nonstop all day, five days a week.  Each day he must drink 4 cans of sprite for 4 different production plants.  Yes, that is 16 cans of pop each day! George starts his first day of work and drinks 16 cans of pop at the end of the day he is sluggish and cranky.  As he continues drinking so much soda he begins to develop a fever, terrible cough and shortness of breath. The symptoms continue to get worst until George can barely breath and needs to be seen by a doctor. Luckily, for George you just happen to be a doctor.  George comes into your office. You are extremely busy and have a lot of other patients so you quickly observe him and conclude that he has some sort of disease.

1. Was your conclusion that George has a disease based on science or superstition? Explain why.
2. Okay you run some more tests and determine George does have a disease, but what does that mean? What is a disease?
3. What are some things that cause a disease?
4. What is a symptom?
5. What are George’s symptoms?

Your body is made up a bunch of systems.  Each system has specific organs that do specific jobs to keep your body running smoothly.  In George’s case, we need to figure out what body system is being affected so that we know where to start looking in order to cure him.  Let’s review the major body systems.

1. Fill in the chart below:

|  |  |  |
| --- | --- | --- |
| Body System | Purpose (3 words or less) | Main Organs |
| **Nervous** |  |  |
| **Digestive** |  |  |
| **Circulatory** |  |  |
| **Reproductive** |  |  |
| **Excretory** |  |  |
| **Respiratory** |  |  |

1. Which of George’s body system is being affected?
2. Why do you think that body system is being affected?

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Okay great, we now know what body system is being affected.   You consult with some colleagues and decide to test if it is the soda causing George’s illness. To do so you set up an experiment using rats.

You take 5 rats and place them in a cage with food water for a week. At the end of the week you measure the number of breaths per minutes for each rat. You then put the rats back in the cage and give them the same food and soda for a week. At the end of the week you again measure the number of breaths per minute for each rat. You obtain the following data from your experiment:

**Data: Mouse First Trail Trial with Soda**

 1 15 breaths/min 43 breaths/min

 2 14 breaths/min 34 breaths/min

 3 12 breaths/min 22 breaths/min

 4 13 breaths/min 38 breaths/min

 5 20 breaths/min 52 breaths/min

The rats we much less active after drinking the soda. The spent most of the day sleeping and were very fatigued. Compared to their previous behavior when they were running around and active

1. What is the control group in your experiment?
2. What is the experimental group in your experiment?
3. What is the variable?
4. What is one piece of **quantitative** data you obtain from your experiment?
5. What is one piece of **qualitative** data you obtained from your experiment?
6. What can you conclude from your experiment? How should you proceed to help George?

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Okay-so we know that something in the soda is making George sick. You decide to take a sample of soda from each production plant. You also take a sample of George’s urine.  To check these, you decide to use the microscope.

1. Label the parts of the microscope below:



1. Explain how you would prepare a wet mount slide for each sample.
2. Great, you have your slide made, explain the steps you would do to get the microscope set up to look at each slide for evidence of contamination.
3. You are a microscope wizard and get it each sample focused perfectly on high power.  If the magnification of the ocular lenses is 10x and the magnification of the objective lenses is 50x.  What is the total magnification?

Here is the image of what you saw under the microscope for each sample. As well as George’s urine sample. We need to determine what those “rods” are in the above image are. You run some more test to determine if the “rods” are alive or not. After running the tests. You determine that the “rods” are alive. Based on this information and the image above

1. What makes something alive? In other words, what are the 6 characteristics of life?.
2. What kingdom of life (Virus, Bacteria, Protist, Plant, Fungus, Animal) do the “rods” belong to? Why?
3. So, we now know what is causing George’s illness. What treatment do you suggest for him?

Part 2: Atkins Diet Overview

The Atkins Diet is a popular diet that focuses on reducing carb intake in favor of consuming [more protein](https://www.verywell.com/ways-to-eat-more-protein-and-lose-weight-3495773)-rich foods. It requires stringent attention to the amount of carbohydrate in the diet, particularly during the first few weeks. The following is an overview of the Atkins Diet:

The Basics of the Atkins Diet

The core concept of The Atkins Diet is Dr. Atkins' theory that over-consumption of and hypersensitivity to [carbohydrates](https://www.verywell.com/what-are-carbohydrates-3496235) is at the root of weight gain.

The principle Atkins bases his plan on says that it is the *way* your body processes the carbohydrates you eat -- not *how much* [fat](https://www.verywell.com/what-is-dietary-fat-3496105?_ga=1.95735708.1660876422.1466096815) you eat -- that causes us to have a weight problem.

Dr. Atkins says that many [overweight](https://www.verywell.com/what-is-overweight-3495556?_ga=1.95735708.1660876422.1466096815) people may be [insulin resistant](https://www.verywell.com/what-is-insulin-resistance-2242260?_ga=1.27791164.1660876422.1466096815) -- the cells that convert [carbohydrates](https://www.verywell.com/what-is-a-carb-2241987?_ga=1.27791164.1660876422.1466096815) into [glucose](https://www.verywell.com/the-oral-glucose-tolerance-test-1087684?_ga=1.27791164.1660876422.1466096815) (which becomes energy) do not work correctly. Atkins suggests it is more likely than not that [most overweight people](https://www.verywell.com/healthy-weight-and-bmi-range-for-older-adults-2223592?_ga=1.6226995.1660876422.1466096815) are [in fact insulin](https://www.verywell.com/insulin-and-diabetes-1087736?_ga=1.6226995.1660876422.1466096815) resistant. Dr. Atkins' remedy to [insulin resistance](https://www.verywell.com/what-is-insulin-resistance-2242260) (or simple over-consumption of carbohydrates) is strict carbohydrate restriction.

In order to follow the Atkins plan, you must begin monitoring and controlling your carbohydrate intake. There are specific foods that are allowed and not allowed during certain portions of the plan. In particular, you must refrain from eating "bad" carbs such as processed, pre-packaged foods and junk foods like cookies [in favor of a protein-rich diet](https://www.verywell.com/how-does-the-atkins-diet-work-3496213).

How Does the [Atkins Diet](https://www.verywell.com/find-your-diet-is-the-atkins-diet-right-for-me-3496200) Work?

By reducing your carbohydrate intake to less than 40 grams a day, you will enter a bodily process called ketosis. Ketosis is a state in which your [body burns](https://www.verywell.com/body-into-fat-burning-machine-1231548) fat as fuel. [Dr. Atkins](https://www.verywell.com/about-atkins-induction-3494693) also says that ketosis will affect [insulin production](https://www.verywell.com/insulin-who-needs-it-and-who-doesnt-1087219?_ga=1.91532442.1660876422.1466096815), which will prevent more [fat](https://www.verywell.com/what-is-body-fat-3495554?_ga=1.91532442.1660876422.1466096815) from being formed.

Dr. Atkins says once you enter ketosis and your body begins efficiently using fat as fuel, your [cravings](https://www.verywell.com/the-urge-to-indulge-how-to-cope-with-cravings-3495797) for carbs will subside and you won't miss the foods you are doing without.

The Phases and the Food

The Atkins Diet consists of the following four stages: [induction](https://www.verywell.com/induction-on-the-atkins-diet-3496357), ongoing weight loss, pre-maintenance, and maintenance.

[Induction](https://www.verywell.com/the-purpose-of-induction-on-the-atkins-diet-3496356) is the first 14 days of the plan, during which [Atkins says](https://www.verywell.com/all-about-the-atkins-diet-3496202) you can lose up to 15 pounds. This rapid weight loss can be attributed to limiting carb intake to 20 grams a day. The only carbs allowed during Induction are [low-carb vegetables](https://www.verywell.com/low-carb-vegetables-list-2242530) like lettuce, broccoli, and tomatoes. (You are limited to three cups per day.) You must eliminate a number of other foods as well, including some that are considered otherwise healthy, such as yogurt, fruit and [starchy vegetables](https://www.verywell.com/list-of-starchy-vegetables-1087454) (like potatoes). A number of [beverages are off-limits during induction](https://www.verywell.com/what-you-can-drink-during-induction-on-the-atkins-diet-3496207), too. During the next stage -- [ongoing weight loss](https://www.verywell.com/atkins-diet-phase-two-ongoing-weight-loss-2241661) -- you can increase your [carb intake](https://www.verywell.com/how-many-carbs-a-day-are-right-for-me-1087029?_ga=1.103606016.1660876422.1466096815)by five grams, but you will eventually hit a plateau and will need to limit your carb intake once again.During pre-maintenance, your rate of weight loss will slow down. You will then be able to "test" certain foods to see if you can safely add them to your diet without weight gain resulting.

Once you reach your [goal](https://www.verywell.com/how-to-set-exercise-and-weight-loss-goals-for-beginners-1229580?_ga=1.103606016.1660876422.1466096815) weight, you enter maintenance and may introduce more carbs back into your diet, but not the "bad" ones, as they will result in weight regain. You will need to choose healthy carbs instead of refined carbs (like white bread) from now on. If you do gain weight, you can restart the plan again at any time.

**Source:**

Atkins, Robert C., MD.*Dr. Atkins' New Diet Revolution*. New York: Avon Health, 2002.

1. There are three types of food (polymers). List them and list their building blocks.

2. What other macromolecule (polymer did we study this semester?)

3. More importantly, what is the main use of each of the three types of food?

4. If you decrease your carbs, this article says you will start using what type for energy?

5. O.k. lets think about how that will affect your body. What parts of your body chemically digest carbs?

6. Where are enzymes made that digest carbs (2 places)?

7. So, one of the problems with this may be the resulting ketosis. This article makes this sounds good (takes more energy to break down food), but ketosis also causes problems in that it creates acidic (low pH) conditions.

 a. Why might this be bad for enzymes?

 b. What else could cause enzymes not to function?

 c. While we’re at it, enzymes are said to be “specific”. What does that mean?

10. People who do the Atkins diet eat a lot of protein. What organs will be affected in that chemical digestion process (where are proteins chemically digested)?

11. Here’s another problem to think about, but you need to know about what elements food is made of. Food is made of 6 main elements (C, H, O, N, P, and S), but all food has three. Which 3?

12. All proteins have an extra element. What is that element?

13. When you break down that element, it’s poisonous to your body. As a result, you turn it into urine. What do you think that will mean to your urine (this isn’t important to your final exam, but it is interesting).

O.k, here we go. Here is a diet for a normal teenager:

*Calories Protein (g) Fat (g) Carbs (g) Fiber (g)*

**Recommended:** 2200 66 73 319 22

Atkins Diet: 2200 305 100 20 5

14. What types of foods would this person eat to have that much protein and fat?

15. Do you see any other problem with this diet?

16. What kind of change is it when you break down food to get it to the building blocks?

17. What does the liver make that you would need more of to help digest fat?

18. Does that substance in 17 act as a physical or chemical change?

19. What gets absorbed in the small intestine and what keeps going?

**Exam Part 3**

Tom Ford is a middle-aged Caucasian male. Tom works in a bank and recently go promoted to bank manager. Tom spends most his time dealing with customers who are interested in obtaining loans from the bank. On December 14, 2016 Tom started his day just like any other. He woke up, drank a whole pot of coffee, said goodbye to his family and headed to work. Once he is at work, he begins dealing with customers. The first man he meets with is Todd Miller. Todd is a big man standing at 6’5’’ and has short brown hair. Todd and his wife have 6 kids. Todd recently lost his job and with Christmas fast approaching he came to visit Tom to ask for a loan to help. Although Tom likes Todd and would like to help him out when he looks at the loan qualifications he understands the Todd does not qualify. Todd is extremely upset about the fact that he did not receive a lone and stores out of Tom’s office yelling “you are going to pay for this”. Tom feels bad about the situation but continues with his day and meets with more people. He then heads to Applebee’s to meet a friend for lunch. When he returns, he meets with his next customer. It is a man named Erick Marshall. Erick is an average sized man, about 6 feet tall with brown hair. Erick and his wife recently got married and he has come to Tom to ask for a loan to help him buy a house. Again, Tom checks to see if they are qualified but unfortunately they have terrible credit because Erick’s wife Allie has a shoe fetish and buys tons of designer shoes. Devastated at the news, Erick storms out of the office mumbling under his breath. Tom continues with his day and eventually heads home for the night. At about 11:30pm Tom is awakened by a phone call saying that someone broken in the bank and stole $300,000 dollars. Tom quickly gets dressed and heads down to the scene of the crime where he meets you. You are a detective and your goal is to figure out which of the two suspect (Todd Miller and Erick Marshall) committed the crime using the evidence left behind.

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So, like all good detectives you need to look at all the evidence.   A witness said that they saw a masked person running out of the building.  The person continued running until he came to a fence which he attempted to jump over a fence but fell.  When he got up and continued running he had a noticeable limp due to a pulled muscle. Great this give us a hint that the suspect may still be walking with a limp. You bring both the suspects down to the police station and realize that neither of the suspects walking with a limp.  How can this be?   Luckily for everyone on the case, you had an excellent biology teacher in high school and can explain how the suspects muscle healed why they no longer have an obvious limp.  To do so we need to remember a few things about DNA and protein synthesis.

1. What is the purpose of DNA?

2. DNA is made up of 3 parts.  What are those 3 parts?

3. What is the building block of DNA called?

4. Which subunits bond together?

5. Explain in detail how a protein is made.

6. How is DNA different than RNA (4 ways)?

7. Name the 3 types of RNA and what each one does.

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Well shoot, that piece of evidence was bust and lead you nowhere.  So, you and your partner head to the scene of the crime to look for more evidence that may have been missed.  As you walk through the bank you realize that there is some blood splattered on the floor near one of the filing cabinets.  Jackpot! You are skilled in the art of Gel electrophoresis and know that you can compare the blood found at the crime scene to the blood of the two suspects.   The DNA found at the scene of the crime and DNA from each suspect are shown below. In order to cut the DNA, we need to use an enzyme.  We choose an enzyme that cuts at TT/GG.

DNA Found At The Crime Scene:

TA-ATT-GGA-TAC-CGG-GCT-GAA-GTC-GAT-TGG-CCA-TGC-TAT-AGC-TTG-GAT-AGC-GAA-TTT-TGG-GCT- CCT-TGG-TAT-AGC

Suspect #1:

TA-ATT-GGA-TAC-CGG-GCT-GAA-GTC-GAT-TGG-CCA-TGC-TAT-AGC-TTG-GAT-AGC-GAA-TTT-TGG-GCT- CCT-TGG-TAT-AGC

Suspect #2

TA-ATT-GGA-TAT-TGG-GCT-GAA-GTC-GAT-TGG-CCA-TGC-TTG-GGC-TTG-GAT-AGC-GAA-TTT-TGG-GCT-CCT-TGG-GCT-AGC

1. If we are going to run a DNA gel electrophoresis, what three things must we do before we put the DNA in the gel?

2. Draw in vertical cuts at each spot that has TTGG. How many cuts are made on the strand of DNA found at the crime scene?

3. How many fragments of DNA does that make?

4. How long is each fragment of DNA?

5. How many fragments of DNA are there for suspect #1? How many fragments of DNA are there for suspect #2?

6. We are ready to load the Gel Electrophoresis now.  We load it at the negative end.  How come?

7. Which pieces of DNA will move the furthest?

8. Look at the results of the Gel Electrophoresis on the Powerpoint.  What can you conclude from the gels?

9. Which suspect committed the crime?

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Great, so we now have an idea on who committed the crime.  However, before we send the man to jail we need to be certain that he is guilty.  There was also a piece of hair found at the scene of the crime. You look at the hair under the microscope and notice that it appears brown in color. The suspect whose blood was found at the crime scene also has brown hair. Normally there is a specific DNA sequence for brown hair as shown below.  However, the hair found at the crime scene from the person who committed the crime does not match the normal DNA sequence but is still brown.  From this we can conclude that a mutation occurred during the transcription phase of protein synthesis.  Using the DNA strands below we need to see what type of mutation occurred.

Normal Brown Hair DNA:

TA-ATT-GGA-TAC-CGG-GCT-GAA-GTC-GAT-TGG-CCA-TGC-TAT-AGC-TTG-GAT-AGC-GAA-TTT-TGG-GCT- CCT-TGG-TAT-AGC

Suspect Brown Hair DNA:

TA-ATT-GGA-TAC-CGG-GCT-GAA-GTC-GAT-TGG-CCA-TGC-TAT-AGC-TTG-GAT-AGC-GAG-TTT-TGG-GCT- CCT-TGG-TAT-AGC

16. Can you look up at the DNA above and find the problem.  Where is it?

17. What type of mutation is it?

18. Using each DNA strand, copy it down into an mRNA strand that is created during transcription.

19. Write down the amino acid sequence that would be made by each of these mRNA strands.

20. What amino acid sequence are different between the two samples?

21.  Mutations can have one of three effects on the individual.  What are the three effects?  What effect did this mutation have the the criminal?

22. Explain how the suspect can have still have brown hair even though there was a mutation.

22.  Based on all the evidence did this man commit the crime?

**Part 4-Regeneration**

Watch the animation showing what newts are able to do.

http://www.hhmi.org/biointeractive/newt-limb-regeneration

1. Why can’t our cells do what we see in the newt’s limb cells?
2. What is the name given to the creation of new cells?
	1. When this happens, how many total cells are made?
	2. In case of a human, how many chromosomes should each of those cells have?
	3. What’s special about those chromosomes in each cell?
3. Draw the 5 stages of this process listed above.
4. O.k, but the cell spends almost all of it’s time in interphase. Draw the cell cycle and label the parts, showing which parts are interphase.
5. So here’s the problem. A person can have an injury to their spinal cord, and we won’t be able to make new cells to replace it. Explain why this is true.
6. Obviously nerve cells aren’t stem cells. What is a stem cell?
7. Give the 3 types of stem cells and divide them.
8. We saw the newt create a new limb. This includes new bones, muscles, nerves, skin, etc. What type of stem cells do you think were in the limb of that newt?

Let’s play mad scientist. What if we put plant cells into the person’s spine to help strengthen it.

1. What three organelles do plant cells have that animal cells do not?
2. Which one might help strengthen the spine?
3. Still, that may not help with the nerve connections. How are nerve cells shaped?
4. Why are they shaped that way?
5. Why are cells shaped differently?
6. So, there are two ways cells are differentiated (look different). Explain the two.
7. How would a pancreas cell look different from a red blood cell?
8. O.k, great. Now what if we did put some stem cells into a person to get nerve cells to regenerate. How would they communicate to other cells? What organelle would be in charge?
9. What are the three ways things go into or out of cells?
10. Which ones are active?
11. Which ones are passive?
12. Draw a cell membrane. Circle the part of the cell membrane that works with active transport. Draw a star next to the part that does passive transport.
13. In the above drawing, which parts are polar and which parts are nonpolar?
14. What is the difference between active and passive transport?
15. So,
	1. Do we undergo mitosis?
	2. When and why?
	3. Do we have stem cells?
	4. If so, what type?