*In compliance with the Dartmouth honor principle, all the work you hand in on this exam is to be your own. Please remember to be **precise** in your wording – scientific descriptions rely on accurate use of specific terms. Also, try to keep your answers **concise**. If you can say something briefly there is no need to create a lengthy answer just to fill up space. Use the space provided and the point values for each question as indicators of the amount of detail your answer should contain. If you really need extra space for an answer, turn the page over and continue your answer on the back of the same piece of paper. To facilitate grading, we separate the exam by page; if your answer is on a different sheet of paper we will not see it. **Please put your name on each page now**.*

If something is not clear to you, please ask me during the exam. That is why I stay in the room. Good luck. - Prof. Gross

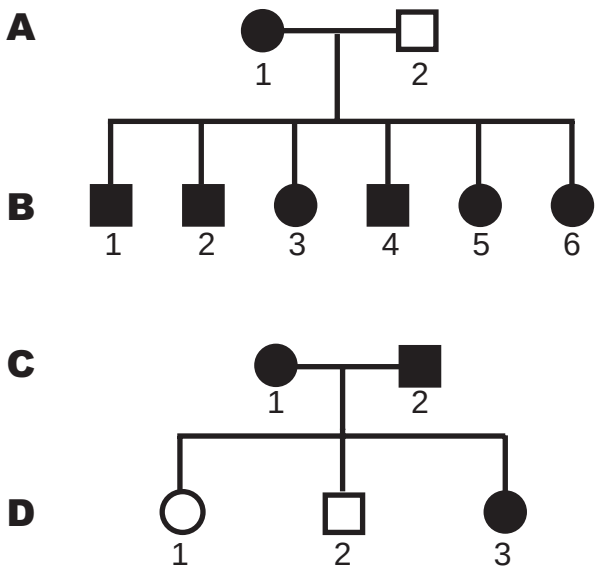
1. We watched a video called "Burden of Knowledge." This video discussed how having more knowledge about a given situation may not always be the best thing. Explain how having the results of an amniotic test may be beneficial in some circumstances and how it might be deleterious in other circumstances. ***10 points***

   (you can use the back of this page if you must, but please try to keep your answer brief)

2. In the video "Who Are You?" we saw a teenager bungi jumping to try to offset a gene he might have inherited from his dad. Explain why he was doing this. ***10 points***

(you can use the back of this page if you must, but please try to keep your answer brief)

3. Using ***B*** and ***b***, give the likely genotype of the individuals in the figure at the right: ***(6 points)***



A-1: *BB*

A-2: *bb*

B-3: *Bb*

C-2: *Bb*

D-2: *bb*

D-3: *Bb or BB*

3. In what way does the quality of ear wax relate to incidence of breast cancer? Explain your answer. ***(6 points)***

Wet ear wax leads to a higher incidence of breast cancer than does dry ear was. Ear wax is produced by the apocrine gland system which includes the mammary glands as well. Apparently, the different alleles in the apocrine gland system that lead to ear wax quality also influence susceptibility to breast cancer.

4. Give an example of a human trait that does not follow Mendel's laws and explain why it does not. ***(5 points)***

several examples are possible but they follow one of the following (only one answer needed):

- ***multigenic/polygenic traits*** *that are the result of many genes contributing to the trait - such as height, shape of nose, etc.*
- ***incomplete dominance*** *is the result of each allele making a product that contributes to the observed trait so that if only one allele is present, the trait is incomplete - such as in flowers that are red because they have two red alleles. If only one allele is present, half as much red pigment is made and the flower is pink*
- ***codominance*** *results when each allele is expressed and that expression does not have an influence on the other allele. An example is the ABO blood types - each allele can make either A antigen, or B antigen, or no antigen. Red blood cells can therefore be AA, AB, AO, BB, BO, or OO.*
- ***sex linked*** *traits are associated with gender - not a Mendelian inheritance*

5. What is meant by genotype and phenotype? ***(4 points)*** Which of these did Mendel study? ***(1 point)***
   Genotype is the set of genes an organism possesses. Phenotype is the set of measurable or recognizable traits that result from the genotype. Mendel studied phenotype

6. Avery and his colleagues determined the nature of the "transforming principle" by digesting S-bacteria extracts with different enzymes before injecting them into mice along with intact R-bacteria. Explain how you would interpret each of these hypothetical results. ***(6 points)***
   a. protease treated extact does not kill mouse, DNAase treated or RNAase treated extract kills the mouse.
   TP is protein - removing RNA or DNA does save the mouse so does not remove TP. Removing protein saves the mouse so must remove TP.

   b. protease treated extract kills the mouse, DNAase treated or RNAase treated extract does not kill the mouse.
   TP is a combination of RNA and DNA - removing protein has no effect so TP does not have any necessary protein component. Removing EITHER RNA or DNA saves the mouse, so TP must contain BOTH RNA and DNA as critical components.

7. What happens during G1-phase of the cell cycle? ***(2 points)***
   the cell grows

8. Explain the process of crossing over during meiosis. Why is it important? ***(3 points)***
   Crossing over is a process in which corresponding parts of chromosome pairs can swap genetic information by having their DNAs cut and reconnected. It is important because it leads to more genetic diversity.

9. Development consists of two basic processes. name those two processes and describe them. ***(4 points)***

   growth *- is the process of cell division which allows the developing embryo to become larger, including all of its component organs.*
   differentiation *-is the process of cells becoming more specialized and acquiring the ability to perform specific tasks unique to that particular cell type.*

10. Explain why telomeres cannot be replicated in the way the rest of the eukaryotic genome is replicated. ***(5 points)***

    All DNA addition must occur by the addition of nts to a perfectly base-paired 3 end. Since one of the DNA strands in a telomere will have to be replicated STARTING at an end, it will be impossible for DNA polymerases to extend from a perfectly base-paired end. Therefore, a different mechanism must be employed.

11. Describe two different membrane bound organelles inside eukaryotic cells and explain their cellular roles. ***(6 point)***

    many organelles: ***nucleus*** *(contains genetic information, chromosomes),* ***mitochondria*** *(responsible for energy production from food),* ***chloroplasts*** *(responsible for photosynthesis),* ***endoplasmic reticulum*** *(involved in protein synthesis and processing, steroid biosynthesis),* ***Golgi apparatus*** *(modification of proteins),* ***lysosomes*** *(contain digestive enzymes and can digest food)*

12. Explain how Mendel demonstrated that different traits are inherited independently? ***(4 points)***

    By doing dihybrid crosses. He found that the presence of one trait (e.g. yellow or green peas) had no influence on any another trait that he measured (e.g. wrinkled or round peas).

13. Cancer cells are immortal. Explain what is meant by this statement. ***(3 points)***

Normal cells can be placed in a Petri dish and allowed to grow and divide. After a fixed number of divisions (usually 50-100), these cells will be unable to divide any further - thus the cells are mortal . On the other hand, cancer cells can keep dividing indefinitely and so are said to be immortal

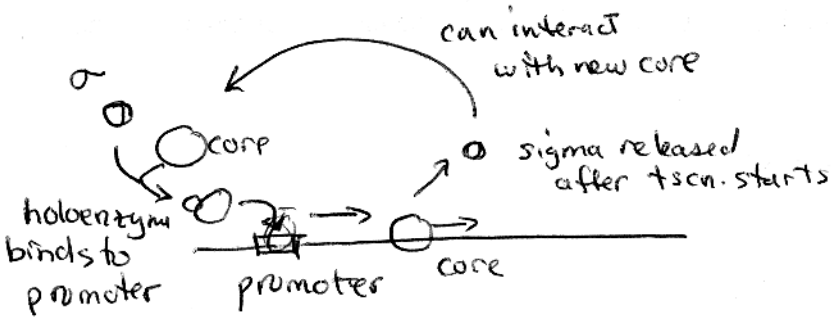
14. Describe the experiments done by Griffith to prove the existence of a transforming principle. ***(5 points)***

.He worked with rough and smooth types of pneumonia bacteria.

- *¥ injected rats with smooth bacteria -> they died*
- *¥ injected rats with rough bacteria -> they lived*
- *¥ heat killed smooth bacteria then injected into rats -> rats lived*
- *¥ mixed heat killed smooth and then mixed with rough and injected -> rats died*

Griffith observed that something was transferred from the components of the killed smooth cell to the rough cell to change the rough cell's behavior. He called this unknown material that was transferred a transforming principle.

16. Diagram and label how σ-factor functions in prokaryotic transcription. ***(5 points)***



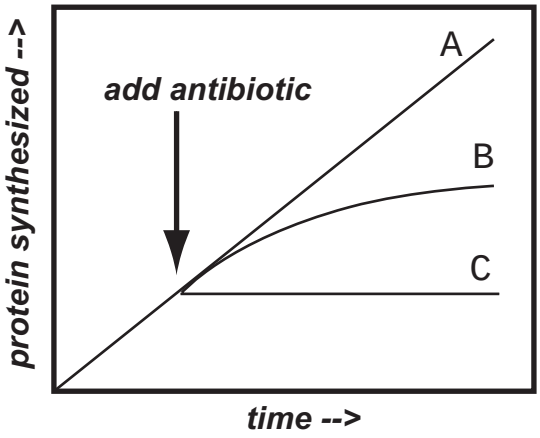
17. Name 4 different varieties of RNA and describe their cellular function. ***(4 points)***

*1) ribosomal RNA (**rRNA**) combine with proteins to form ribosomes which are used for protein synthesis (more in next lecture)*
*2) messenger RNA (**mRNA**) carries the information encoded in the DNA to the cytoplasm where it can be used as a template for protein synthesis*
*3) transfer RNA (**tRNA**) is also involved in protein synthesis and it brings new amino acids to the protein synthesis machinery to help build proteins. AAs are building blocks to proteins just as bases are building blocks to DNA and RNA.*
4) small nuclear RNA (snRNA) is involved in pre-mRNA splicing

18. Some single stranded RNA phage contain several coding regions on a single polycistronic mRNA, yet immediately after infection only the first coding region is translated. Slightly later on, additional coding regions are translated. How does this happen? ***(5 points)***

The first start codon is available when the RNA enters the cell and is therefore translated. Other start codons are not available initially because they are involved in base-pairing to other regions on the RNA. During translation of the first gene region, the ribosomes disrupt the previously base-paired regions making their start codons available. These newly available start codons will be recognized and utilized

19. In order to test the effects of two different antibiotics on protein synthesis, you set up three testubes to carry out protein synthesis. No antibiotic is added to tube A, antibiotic B is added in tube B, and antibiotic C is added in tube C. From the graphs shown here, explain whether B and C are acting during the elongation or initiation step of protein synthesis. ***(6 points)***



C: translation stops immediately so no additional protein synthesis occurs (no more amino acids are added to proteins). This is only possible if elongation is blocked

B: in this case, there is not an immediate cessation of protein synthesis. Since more protein synthesis continues to occur (additional amino acids are added to proteins), but gradually tapers off, this indicates that elongation continues until the protein is finished but no more initiation can occur. So B blocks initiation