Genetics of Blood Type Lab; SB2 c,f

There are multiple alleles that determine an individual's blood type and these alleles exhibit dominant, recessive and co-dominant inheritance patterns. In the immune response, the body produces antibodies, which are small polypeptides that recognize and help to eradicate foreign substances called antigens. Antibodies have a specific shape (like enzymes) and bind to specific antigens causing the antibody-antigen complex to clump, or agglutinate. There are two different types of antigens (A and B) that can be found in the cell membrane of human red blood cells. Humans normally produce antibodies against the antigens that are not on their cells. For example, a person with A antigens has antibodies against B and someone with B antigens has anti-A antibodies. A person that lacks both A or B antigens has antibodies against both, while someone with both A and B antigens does not have either antibody type. Thus, AB blood type exhibits co-dominance, as both traits are expressed in this particular phenotype. During a transfusion, if incompatible blood types are mixed the antibodies will attack the foreign blood cells resulting in potentially fatal clumping or agglutination. The four blood types are: A, B, AB, and O. Type O blood, which is recessive, lacks both A and B antigens, and thus, can be given to people with any blood type. Whereas, type AB can receive blood of any type since this phenotype lacks A and B antibodies. The purpose of this lab is to apply your knowledge of dominant, recessive and co-dominant traits through a simulated blood transfusion. This will demonstrate how multiple alleles can interact in our bodies, which in turn, will emphasize the relevance of our curriculum.

Blood Type	Antigens	Antibodies	Can give blood to:	Can receive blood from:
A	A	Anti-B	A, AB	O, A
B	B	Anti-A	B, AB	O, B
AB	A and B	Neither	AB	O, A, B, AB
O	Neither	Both	O, A, B, AB	O

Pre-Lab: In addition to the usual lab write-up, you will need to copy down tables 1 and 2, read through the entire lab and answer the following five pre-lab questions:

1. Describe the major differences between antigens and antibodies.

2. What does agglutinate mean and when would this occur?

3. Draw a Punnett square showing all the possible blood types for the offspring produced by a type "O" mother and an a Type "AB" father.

4. Mrs. Exemplar is type "A" and Mr. Exemplar is type "O." They have three children named Matt, Marc, and Sam. Marc is type "O," Matt is type "A," and Sam is type "AB." Based on this information:

a. Mr. Exemplar must have the genotype _____

b. Mrs. Exemplar must have the genotype _____ because _____ has blood type _____

c. Sam cannot be the child of these parents because neither parent has the allele _____.

5. How are antibodies like security guards? Justify your response.

Scenario: A severely injured man has been brought into the emergency room. He has lost a great amount of blood; to survive, he must receive a blood transfusion. This man is unconscious and has no belongings, so the hospital staff does not know his blood type. His blood type must be determined!

Part A: ABO Blood Typing:

1. Obtain five blood typing trays, set them on a paper and label them #1 Mr. Smith, #2 Mr. Jones, #3 Mr. Green, #4 Ms. Brown and #5 Recipient (label the paper not the actual trays).

2. Place 2 drops of Mr. Smith's blood in each of the A and B wells of tray #1.

3. Repeat this process for each individual ending with 2 drops in each A and B well of tray #5 (recipient).

4. Add two drops of anti-A serum to each of the A wells on all five plates. Add two drops of the anti-B serum in the B wells of all five plates.

5. Obtain two toothpicks per blood typing tray. Stir each with a clean separate toothpick for 30 seconds. Do not cross contaminate. You are looking for the presence or absence of clumping called agglutination. Observe each tray and record observations in table 1 of the results, simply record "agglutination" or "no agglutination" and the blood type.

Clean and return the blood typing trays and the toothpicks now.

Part B: Cross Matching:

1. Predict which of your possible donors will be compatible with your recipient and fill in table 2 of the results section.

2. Label four microcentrifuge tubes with numbers 1-4.

3. Place 2 drops of Mr. Smith's blood in tube #1 and continue this methodology ending with Ms. Brown (tube 4).

4. Add 2 drops of the simulated recipient's serum to each of the four tubes.

5. Observe each tube for a reaction. You may need to hold the tube up to the light. Record results in table 2.

Table 1:

	Anti-A Serum	Anti-B Serum	Blood Type
#1 Mr. Smith			
#2 Mr. Jones			
#3 Mr. Green			
#4 Ms. Brown			
#5 Recipient			

Table 2:

Name	Predicted Compatibility		Observed Compatibility	
	No	Yes	No	Yes
#1 Mr. Smith				
#2 Mr. Jones				
#3 Mr. Green				
#4 Ms. Brown				

Post Lab Questions:

6. Explain Mendel's *principle of independent assortment*. When might this principle not apply?

7. Define polygenic inheritance and give an example of a character that is polygenic.

8. If a father's blood type is B and a mother's blood type is A, is it possible that their child could have blood type O? Explain your response.

9. List the possible combinations of alleles in the gametes of an individual with the genotype AaBb.

10. Briefly explain why each statement is inaccurate or misleading.

a. If the first time you flip a penny you see a tail, the next flip is more likely to show a head.

b. If you buy two plants of the same species that have the same-colored flowers, they must have different genotypes.

11. Two parents think their baby was switched at the hospital. Its 1968, so DNA fingerprinting technology does not exist yet. The mother has blood type "O," the father has blood type "AB," and the baby has blood type "B."

a. Mother's genotype: _____

b. Father's genotype: _____

c. Baby's genotype: _____ or _____

d. Punnett square showing all possible genotypes for children produced by this couple

e. Was the baby switched?

12. In the above scenario, explain how DNA fingerprinting could be utilized to sole the probe. In your answer, outline details of the process of DNA fingerprinting including gel electrophoresis.

13. *Big Picture Connection*: Write a short paragraph to explain the concept of protein synthesis in the context of blood type. At minimum, you must use and <u>underline</u> the following terms: amino acids, antigens, meiosis, DNA, mRNA, tRNA, antibodies, co-dominance, ribosome, RNA polymerase, nucleus, eukaryote, law of segregation