

Name: _____

Section: _____

Question 1, continued

c) What does synchronization do to the cells and why is it necessary for this experiment?

d) Why does low serum or no serum synchronize your cells?

e) Since you used PDGF in your experiment and it stimulates your cells to divide, you assume the alien cells contain a protein similar to the PDGF receptor. How does PDGF binding to the receptor cause the activation of the receptor and subsequent promotion of the cell cycle?

Question 2

Your professor Flow Enirehtac asks you to learn more about the PDGF receptor inside these alien cells. In order to discover the function of various regions in the protein you create cells that no longer express the wild type form of the receptor but various truncated forms.

You then use an antibody against the PDGF receptor in order to visualize where in these cells the protein is located. You find that the PDGF receptor protein is found in the cytosol of all the cells.

a) All the truncated forms of the PDGF receptor are missing sequence from one end.

- Which end of the receptor protein is likely to have been deleted?
- Why would this deletion change the localization of the PDGF receptor?

b) You look closely at many other cell lines that fail to respond to PDGF.

i) Type 1 cells have a single gene mutation and fail to respond to all growth factors. Antibody staining of these cells shows that many different membrane proteins are now found free in the cytoplasm. Which component(s) of the protein secretion pathway might be missing in Type 1 cells.

ii) What other kinds of proteins might be affected in Type 1 cells?

iii) Type 2 cells do not respond to PDGF because PDGF receptor proteins are secreted out of the cell. What kind of mutation would lead to this result?

Question 3

In order to study genes involved in the progression of cancer you do gene expression analysis. To do this you compare the mRNA levels of normal cells versus tumor cells. What you find from this experiment is that some genes are upregulated in the tumor cells i.e. they have an increase in the mRNA levels of a certain gene and that some genes are downregulated in the tumor cells meaning that they have a decrease in the mRNA levels of certain genes. You also have some genes whose mRNA levels stay the same.

- a) What is the most likely function of the genes that are upregulated in the tumor cells?

- b) What is the most likely function of the genes that are downregulated in the tumor cells?

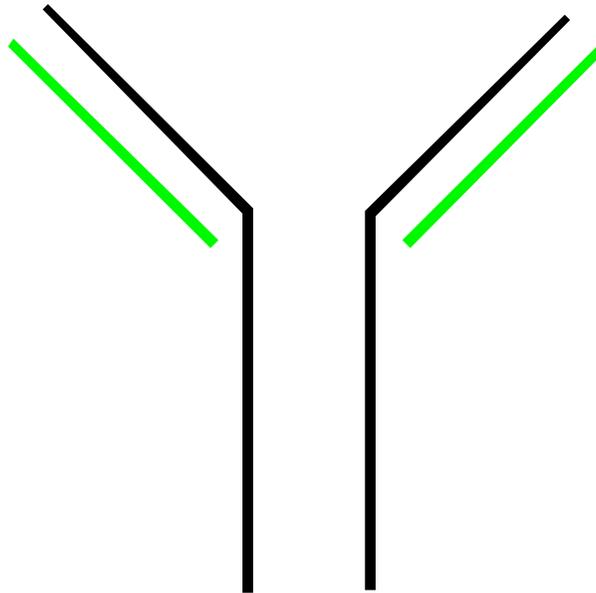
- c) What is the most likely function of the genes that are the same in tumor and normal cells?

- d) You find out later that one of the genes whose mRNA levels stayed the same actually plays a critical role in the progression of cancer. How can this be?

- e) You clone the gene from (d) and you discover that it is p21^{Ras}. You then take normal fibroblasts and overexpress this allele of the Ras gene in them. To your surprise the cell do not proliferate, but stop dividing. Give an explanation of for this outcome.

Question 4

Shown below is a schematic representation of an antibody made in B cells.



a) Label the following structures (i) – (v) on the antibody diagram.

i) the light chains

ii) the heavy chains

iii) the antigen binding sites

iv) the variable regions

v) If this were a secreted antibody, indicate the region of the antibody that would interact with macrophages.

vi) If this were a membrane-bound antibody, indicate the membrane-spanning region of the antibody.

b)

i) List **two** ways that antibody diversity is created.

ii) What are the interactions between the light and heavy chains that make them associate with each other? What kind of bonding is this?

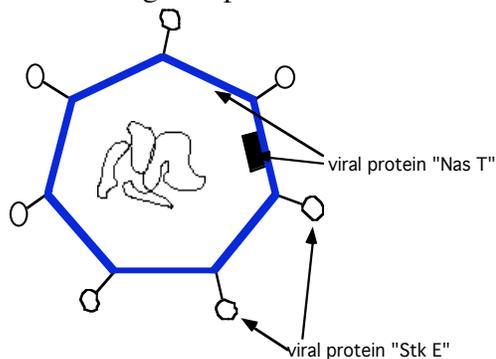
Question 4, continued

c) Name the cell type of the immune system that would:

- i) bind an antigen floating around in the blood.
- ii) recognize an antigenic peptide on a MHC Class II protein displayed by a macrophage.
- iii) recognize an antigenic peptide on a MHC Class I protein displayed by an infected skin cell.
- iv) nonspecifically engulf and digest a variety of pathogens (disease-causing organisms).
- v) secrete large amounts of antibody in response to an infection.
- vi) recognize a viral infected body cell and destroy it.
- vii) Provide long-lived immunity to measles in children immunized against the measles virus by injection of viral proteins.

d) Will an individual who does not express MHC Class II proteins on the surfaces of B cells and macrophages produce a humoral immune response? Explain your answer.

e) Below is a drawing of a putative human virus pathogen.



i) Which viral protein(s) is likely to raise an antibody response in a natural infection? Why?

ii) Which viral protein(s) likely trigger a cell-mediated response (killer T cell lines) in a natural infection? Explain your answer.

Question 4, continued

f) State whether the following are true or false. If the statement is false, explain why it is false.

i) Memory B cells generated in a primary immune response give rise to antibody-secreting cells during a secondary immune response.

ii) Only the variable regions of antibodies make actual contact with the epitopes (antigenic determinants) of the appropriate antigen.

iii) Helper T cells (T_H) are involved in the activation of both B cells and cytotoxic T cells.

iv) Antibody molecules are bivalent, which means they bind two unrelated antigens simultaneously.

v) Humoral immunity involves circulating antibodies that defend against free bacteria and viruses. Cell-mediated immunity is carried out by specialized T cells that target infected body cells.

g) When an activated helper T cell (T_H) binds to a B cell presenting the appropriate antigen on the B cell's Class II MHC molecules, the T_H activates the B cell. This stimulates the B cell to proliferate and make more antibodies to fight the invasion.

i) Why must the T_H and B cells specifically bind in order for this activation to occur? Why don't the activated T_H cells simply secrete an activating hormone into the blood without ever binding to a B cell?

ii) When the animal is no longer fighting the infection, and the antigen is cleared from the body, many of the B cells die since they are no longer needed. Some however, continue to survive. What function do these cells provide?