Problem 1. Short answer.

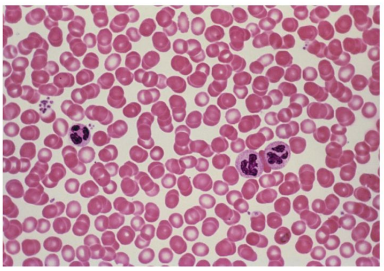
(a) What is the difference between cytoplasm and cytosol?

(b) What is a protein? Provide a formal definition.

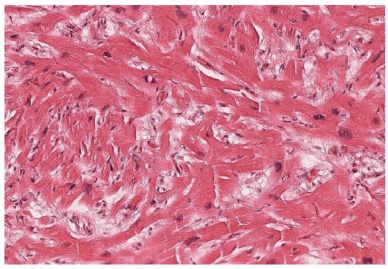
(c) What does it mean to be *selectively permeable*? What are the benefits of having a selectively permeable membrane?

(d) Describe the Central Dogma in sufficient detail. Be sure to mention where transcription and translation take place.

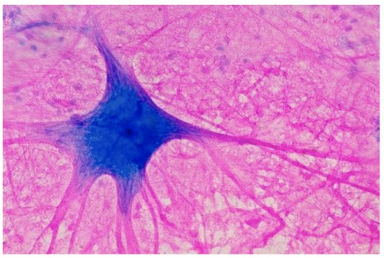
Problem 2. Identify the cells that are shown in the following images.



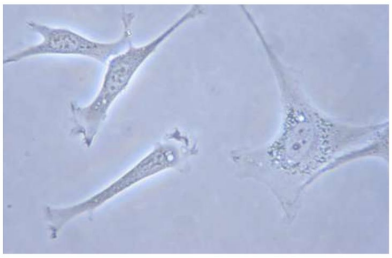
(A)



(B)



(C)



(D)

Fill in the blanks with the corresponding letter. Choose (E) if the type of cell does not correspond with any of the four images above.

(a) Picture _____ contains myocytes.

(b) Picture _____ contains red blood cells.

(c) Picture _____ contains cancer cells.

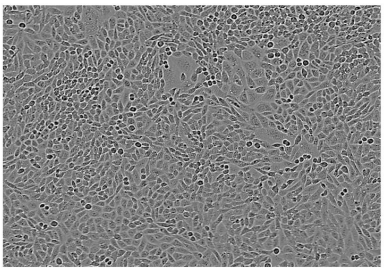
(d) Picture _____ contains fibroblasts.

(e) Picture _____ contains macrophages.

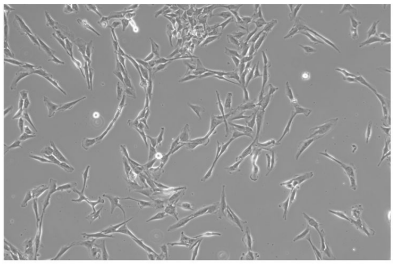
(f) Picture _____ contains endothelial cells.

(g) Picture _____ contains neurons.

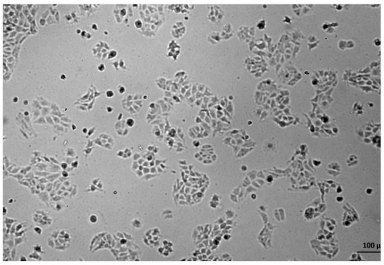
Problem 3. Estimate the cell confluency in the following images.



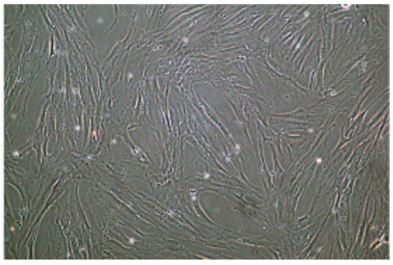
(A)



(B)



(C)



(D)

Fill in the blanks with your estimations.

(a) Picture A contains cells at _____ percent confluency.

(b) Picture B contains cells at _____ percent confluency.

(c) Picture C contains cells at _____ percent confluency.

(d) Picture D contains cells at _____ percent confluency.

Problem 4. Short answer and multiple choice.

(a) Many antibiotics work by targeting and disabling the ribosomes of prokaryotic cells. Which part of the Central Dogma is affected by this? Explain.

(b) Recall that a fluorophore is a type of molecule that emits a specific wavelength when conjugated to a certain type of protein or biological molecule. Ethidium homodimer is a fluorophore that fluoresces red when it binds to DNA. However, it only emits this color in the presence of dead cells and fails to fluoresce in the presence of live cells. Explain why.

(*Hint*: Think about the behavior of cell membranes.)

(c) What cell type would you expect to have the least amount of mitochondria? (*Hint*: Mitochondria is an organelle that generates energy for the cell.)

- ◯ Neurons, which transmit sensory and cognitive information throughout the nervous system.
- ◯ Red blood cells, which move passively through the bloodstream.
- ◯ Myocytes, which allows your muscles to generate force.
- ◯ Stem cells, which differentiate into other types of cells.

(d) What cell type would you expect to have the greatest amount of lysosomes? (*Hint*: Lysosomes are organelles that contain digestive enzymes.)

- ◯ Stem cells, which differentiate into other types of cells.
- ◯ Myocytes, which allows your muscles to generate force.
- ◯ Macrophages, which digests foreign materials and harmful species like certain microorganisms and tumor cells.
- ◯ Red blood cells, which move passively through the bloodstream.