
بسم الله الرحمن الرحيم

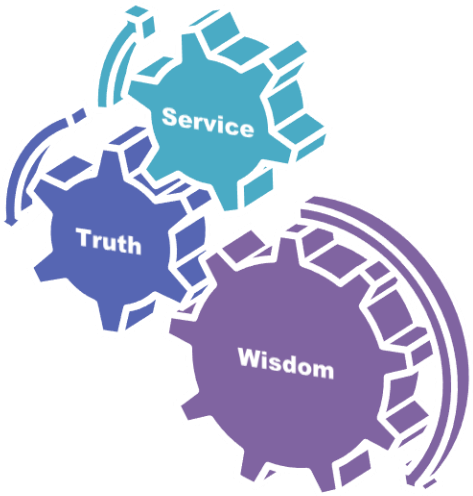
First Year MBBS (Batch 51)
Foundation Module
Practical/Skill lab
Introduction to Centrifuge Machine

Dr. Maryam Abbas

25th January,2024

Table of Contents

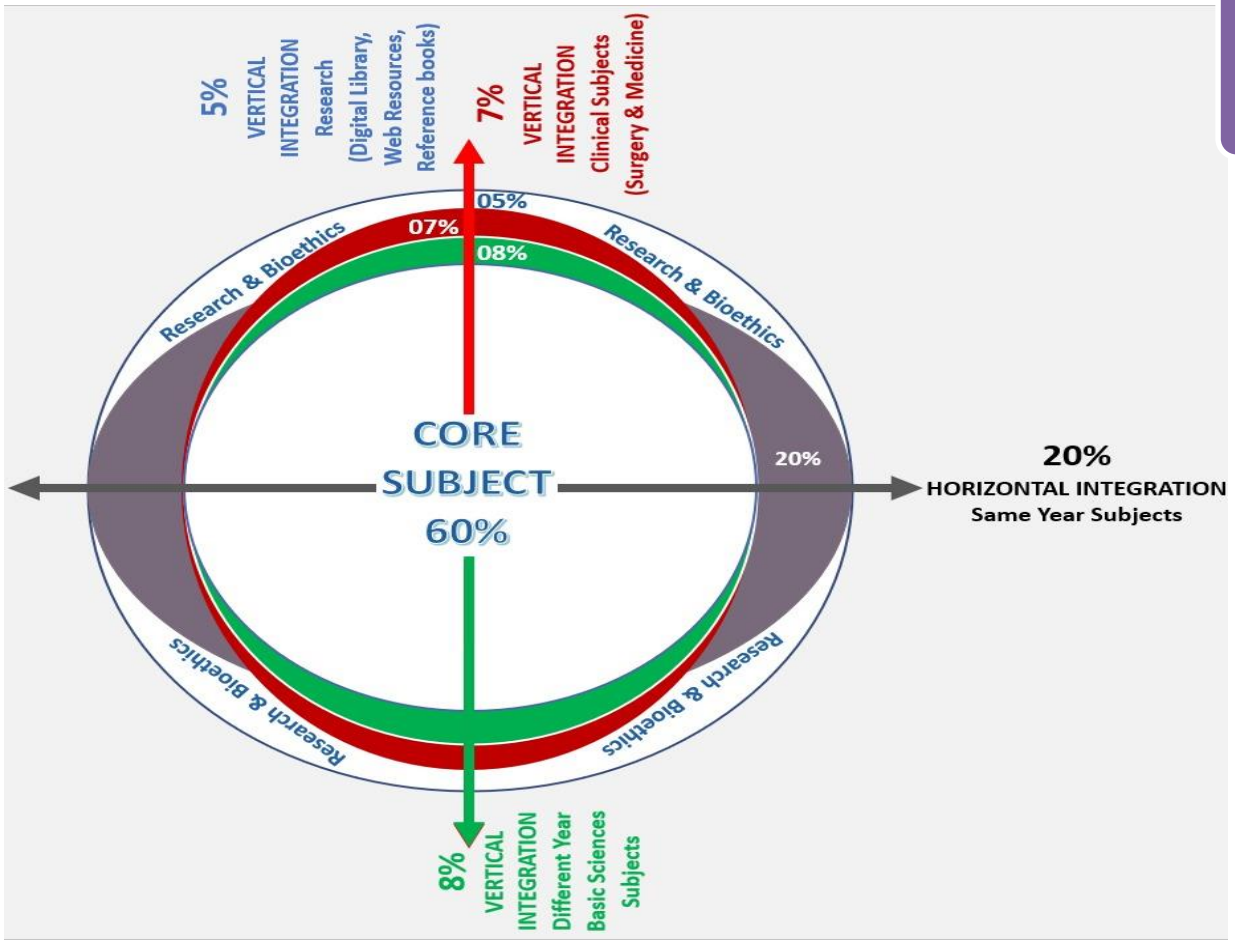
Motto



Vision; The Dream/Tomorrow

- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

Professor Umar Model of Integrated Lecture



60% CORE SUBJECT

20% HORIZONTAL INTEGRATION
Physiology
biochemistry

8% VERTICAL INTEGRATION
Pathology
pharmacology

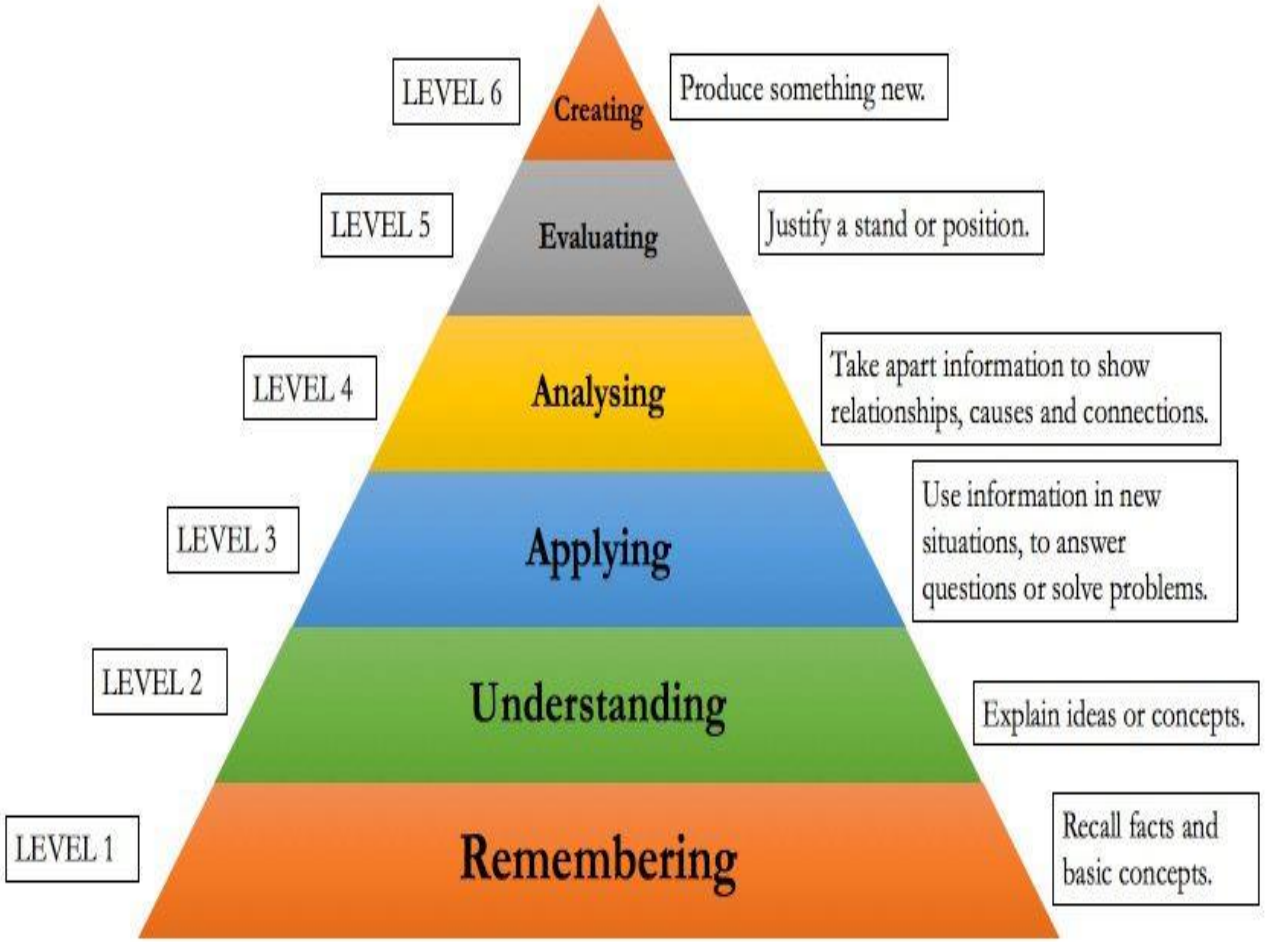
7% VERTICAL INTEGRATION
Clinical integration

5% VERTICAL INTEGRATION
Research, professionalism
Ethics
Digital library

BLOOM'S TAXONOMY : DOMAINS OF LEARNING

Sr. #	Domain of learning	Abbreviation	Levels of the domain	Meaning
1	cognition	C	C1	Recall / Remembering
2			C2	Understanding
3			C3	Applying / Problem solving
4	Psychomotor	P	P1	Imitation / copying
5			P2	Manipulation / Follows instructions
6			P3	Precision / Can perform accurately
7	Attitude	A	A1	Receiving / Learning
8			A2	Respond / Starts responding to the learned attitude
9			A3	Valuing / starts behaving according to the learned attitude

Diagrammatic Representation of Blooms Taxonomy



Learning Objectives

Sr. #	Learning Objectives	Domain of Learning
1	To Understand concept of Centrifuge Machine	C2
2	To Explain Hematocrit	C2
3	To Perform Procedure of Hematocrit measurment by the use of centrifuge machine	C1,P3,A3

Micro Hematocrit Centrifuge machine

Points of identification (centrifuge machine)

- This machine is identified by its different parts which are as follows:
- Power
- Braker
- Timer
- Opening lid
- Rotor

Principle Of Centrifuge Machine

- When anticoagulated whole blood is centrifuged, the space occupied by the packed red blood cells is defined as the hematocrit (HCT), and is expressed as the percent of red blood cells in a volume of whole blood.

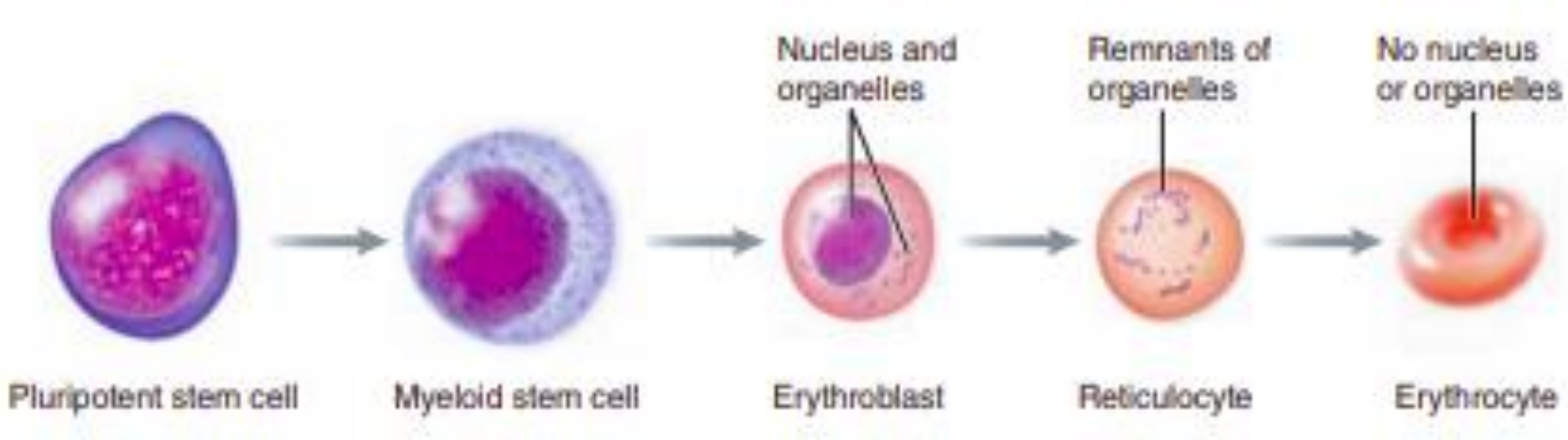
Mechanism of Centrifuge Machine

- A centrifuge works by **using the principle of sedimentation**: Under the influence of gravitational force (g-force), substances separate according to their density.

Function of Centrifuge Machine

- **Hematocrit** is a blood test that **measures how much of a person's blood is made up of red blood cells**. This measurement depends on the number of and size of the red blood cells. Blood transports oxygen and nutrients to body tissues and returns waste and carbon dioxide.
- **Centrifuge Machine** is used to measure hematocrit.

Development of Red Blood cells



Reference: Sherwood 9th Edition page number 384

Vertical Integration

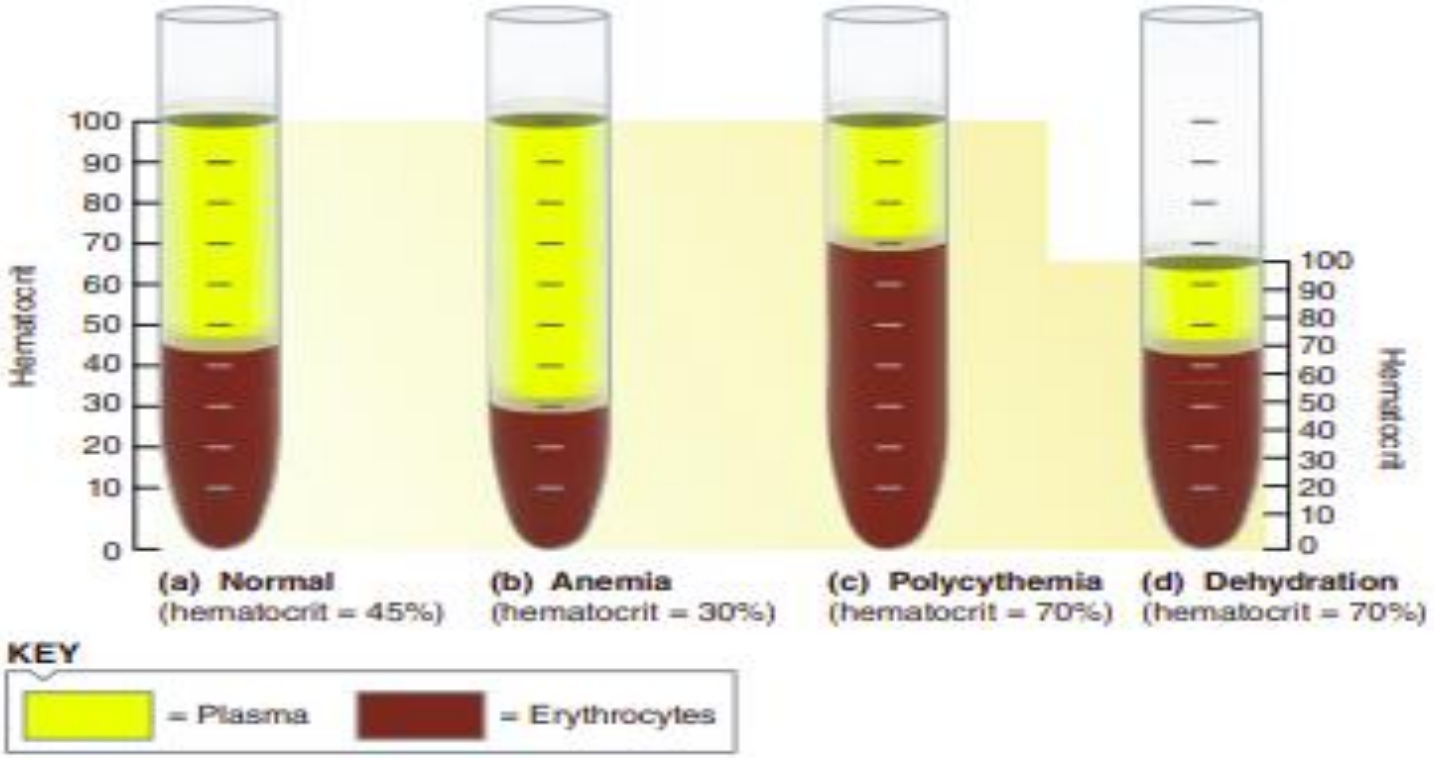


Figure 11-5 Hematocrit under various circumstances. (a) Normal hematocrit. (b) The hematocrit is lower than normal in anemia because of too few circulating erythrocytes. (c) The hematocrit is above normal in polycythemia because of excess circulating erythrocytes. (d) The hematocrit can also be elevated in dehydration when the normal number of circulating erythrocytes is concentrated in a reduced plasma volume.

Reference: Sherwood 9th Edition page number 387

Example

A 70-year male smoker known case of severe chronic obstructive pulmonary disease presented to Family medicine outpatient department with complaints of shortness of breath, fatigue and dizziness. On examination his cheeks had reddish blue appearance, his CBC revealed 7 million /mm3 and hematocrit 70%. This condition is **polycythemia**. What will be role of **family physician** in this condition?

- Approach of family physician in this scenario will be:
- History
- Examination
- Appropriate investigations
- Refer to patient to clinical hematologist.

Bioethics

Lesson Of The Day
Consent

Consent is the “autonomous authorization of a medical intervention by individual patients.

Relevant Case: If you want to draw sample of hospitalized patient ,you must ask from patient before sampling.

Suggested Research Article

Microfluidics and Nanofluidics (2024) 28:10
https://doi.org/10.1007/s10404-023-02704-w

RESEARCH

Label-free cancer cell separation from whole blood on centrifugal microfluidic platform using hydrodynamic technique

Chun-Chi Lin[1] · Jui-Chi Tsai[1] · Yi-Zhi Liu[1] · Ju-Nan Kuo[1]

Received: 7 July 2023 / Accepted: 12 December 2023

Abstract
The separation of cancer cells from blood samples is one of the most crucial tasks in cancer research. However, existing methods tend to be expensive and labor intensive. Accordingly, the present study proposes a low-cost platform that uses hydrodynamic effects for the label-free separation of cancer cells from whole blood samples using a simple centrifugal microfluidic device consisting of a Y-shaped microchannel, a contraction–expansion array (CEA) microchannel, and a bifurcation region. To enhance the separation efficiency, the input branches of the Y-shaped microchannel are designed with different widths to generate a sheath flow rate greater than the sample flow rate. As the sample flows through the CEA microchannel, the cancer cells are separated from the blood cells through inertial effects and the bifurcation law. Finally, the cancer cells are collected from the low-flow-rate branch of the bifurcation region. The feasibility of the device is first demonstrated by numerical simulations. Experimental trials are then performed to separate K562 cancer cells from blood samples with various hematocrit concentrations at disk rotational speeds ranging from 1000 to 3000 rpm. The experimental results show that the cancer cells can be successfully separated from a diluted blood sample with a ratio of $1{:}1.2\times10^5$ K562 cells to blood cells with a high efficiency of 90% at an angular velocity of 2000 rpm.

Keywords Cancer cell · Centrifugal microfluidic · Contraction–expansion array (CEA) · Hydrodynamic · Label free

Journal Name: Microfluidics and Nanofluidics 2024

Reference: https://link.springer.com/article/10.1007

Crux of Suggested Research Article

- The separation of cancer cells from blood samples is one of the most crucial tasks in cancer research.
- The experimental results of this research trial show that the cancer cells can be successfully separated from a diluted blood sample with a ratio of $1:1.2 \times 10^5$ K562 cells to blood cells with a high efficiency of 90% at an angular velocity of 2000 rpm.

How To Access Digital Library

- **Steps to Access HEC Digital Library**

1. Go to the website of HEC National Digital Library.
2. On Home Page, click on the INSTITUTES.
3. A page will appear showing the universities from Public and Private Sector and other Institutes which have access to HEC National Digital Library HNDL.
4. Select your desired Institute.
5. A page will appear showing the resources of the institution
6. Journals and Researches will appear
7. You can find a Journal by clicking on JOURNALS AND DATABASE and enter a keyword to search for your desired journal.

Brainstorming

Multiple Choice Question related to Topic

Q.NO.1: Mechanism of centrifugation is used for the measurement of:

A. Hematocrit
B. Erythrocyte sedimentation rate
C. Red blood cell count
D. Total leukocyte count
E. Bleeding time

Multiple Choice Question related to Topic

Q.NO.1: Mechanism of centrifugation is used for the measurement of:

a) Hematocrit*

b) Erythrocyte sedimentation rate

c) Red blood cell count

d) Total leukocyte count

e) Bleeding time

REFERENCES

1. Books:

- Guyton And Hall textbook of Medical Physiology 14th Edition
- Ganong's Review of Medical Physiology 25th Edition
- Sherwood, 9th edition.
- Silverthorn Physiology,6th edition
- Vander's Human Physiology,14th edition
- Google images.

2.Medical Journal articles:

Reference: https://link.springer.com/article/10.1007

3.Video link /youtube:

https://youtu.be/JtBtk00EiVM?si=y-2DAPW49eQwqU6N

Take Home Message

- **Core knowledge:**
- Introduction to Centrifuge Machine
- **Integration:**
- Histology of Erythropoiesis

- **Research:**
- Label-free cancer cell separation from whole blood on centrifugal microfluidic platform using hydrodynamic technique
- **Biomedical Ethics: Consent** is the “autonomous authorization of a medical intervention by individual patients.

- **Family Medicine:** Polycythemia scenario


Thank
you