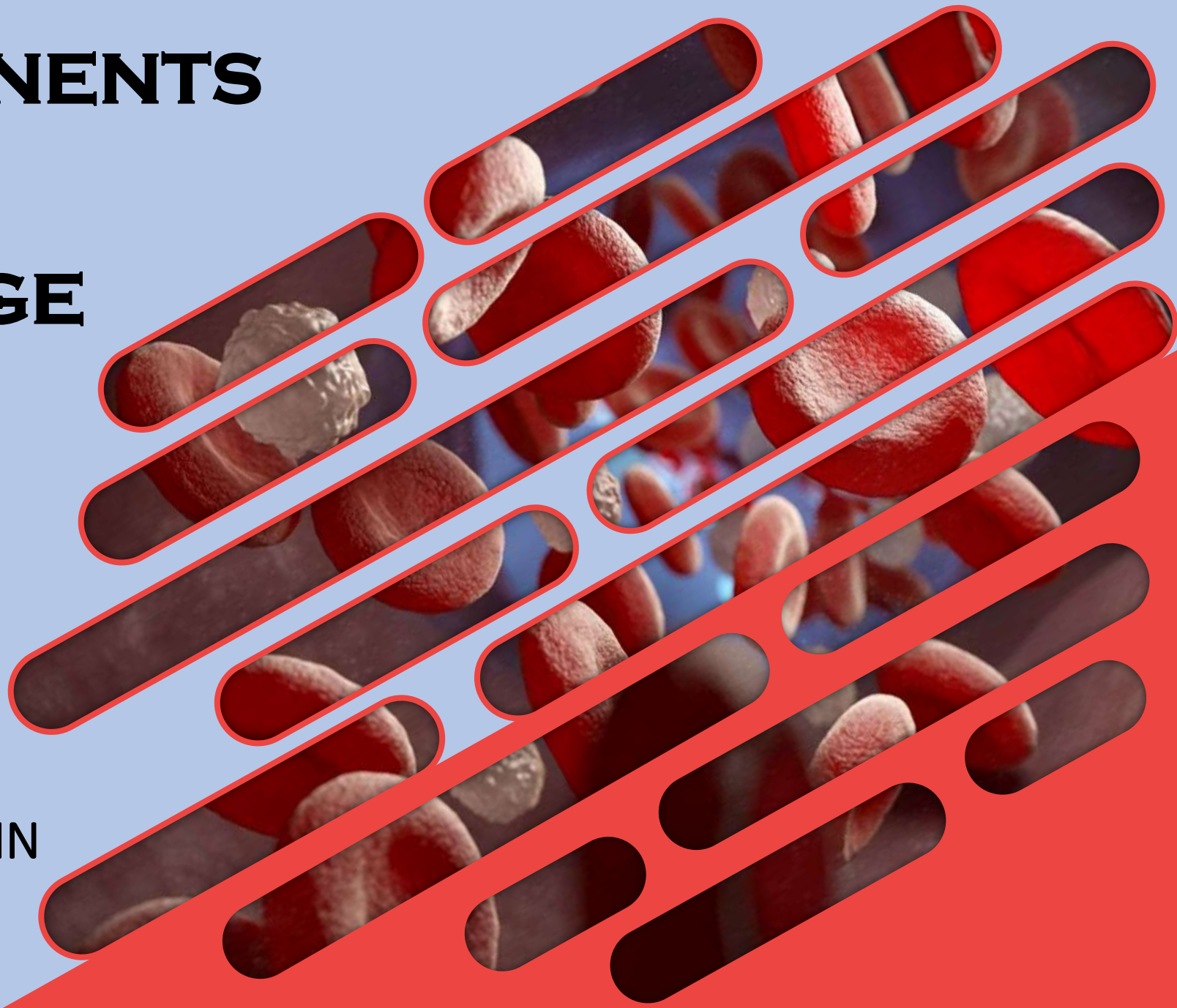
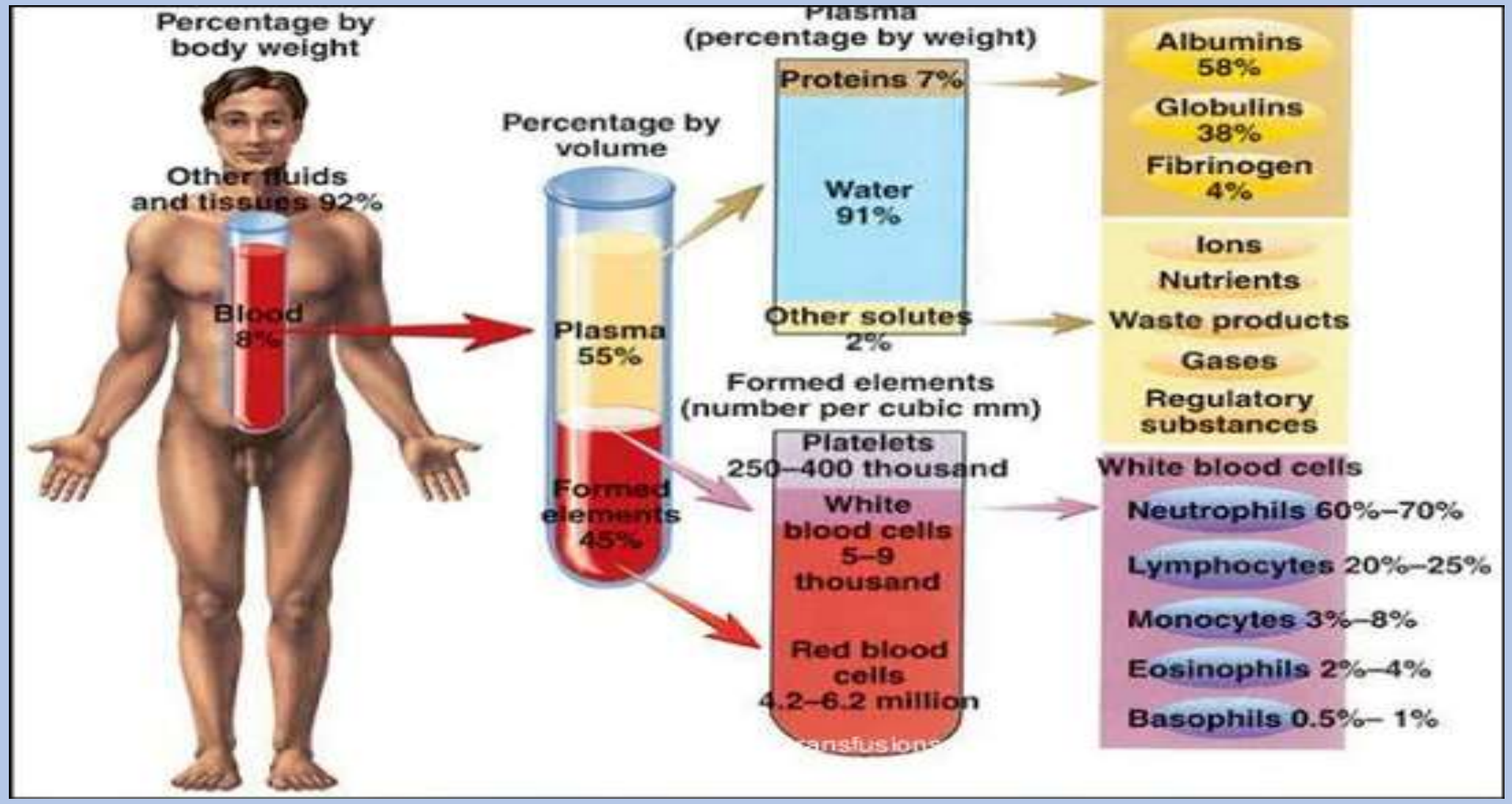
BLOOD COMPONENTS AND THEIR USAGE



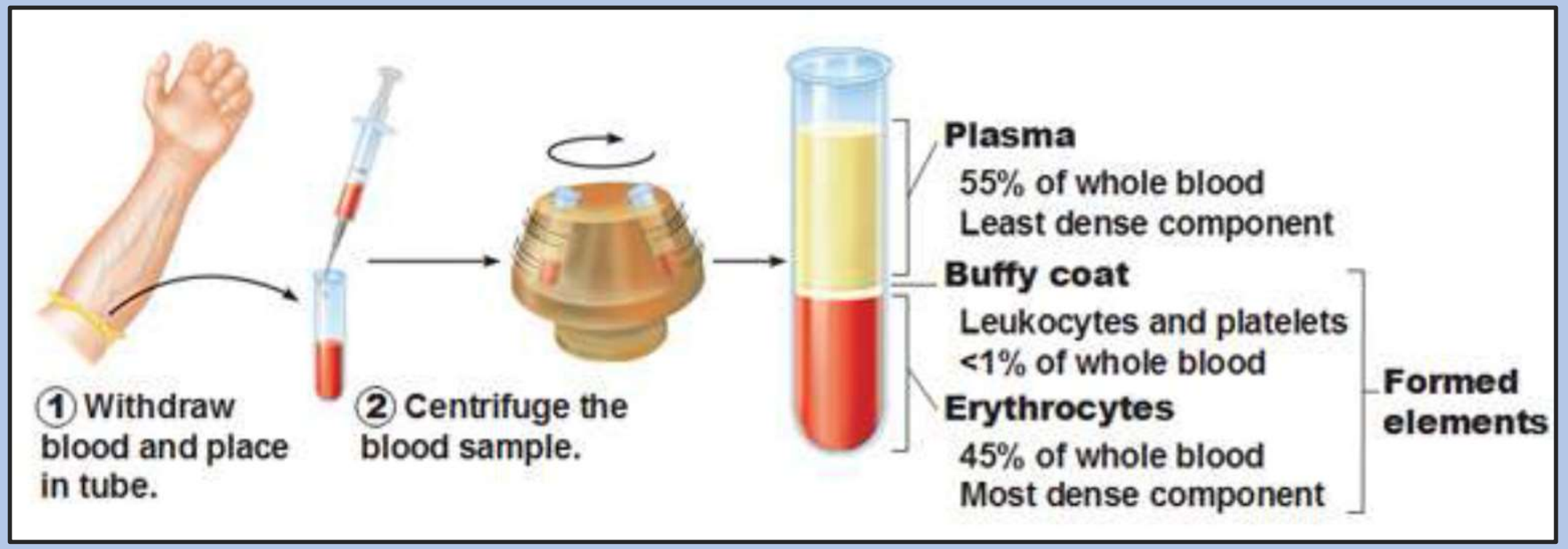
SUBMITTED BY:

LAM YAN SHIM
NOR NAIMAH BT SHAMSUDDIN

Composition of Blood



Major Components of Whole Blood

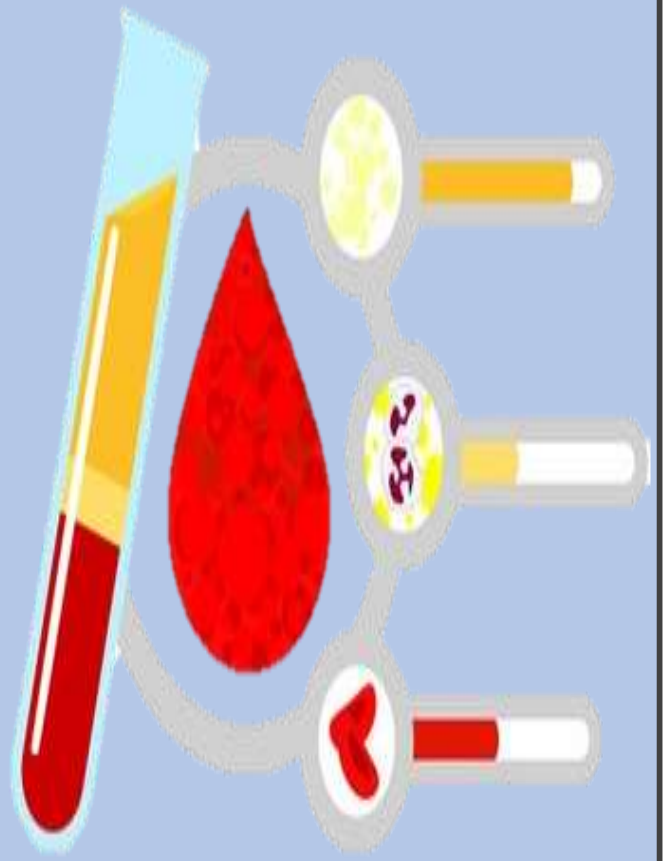


➔ Blood components are those derived from whole blood collected from normal donors

➔ Basis of separation of the blood - **CENTRIFUGATION !!**

- Blood will be separated into few components based on their specific gravity

Importance of Blood Component Separation

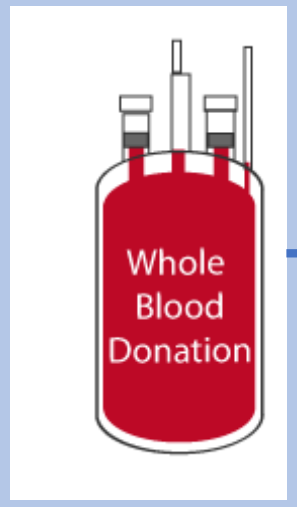


- Allow optimal survival of each constituents
  - → In whole blood stored at 2-6˚C, platelets stay viable for 1 day, Factor V and VIII decrease
  - → While after separation, platelets stay up to 5 days, Factor V and VIII can be stored as FFP for 1 year at -30˚C
- Allow transfusion of only required blood component to the patient
- Avoid the use of unnecessary component which could be contraindicated in a patient
- Maximize the use of blood donations
  - → Several patients can be treated with the blood from one donor

Blood Components

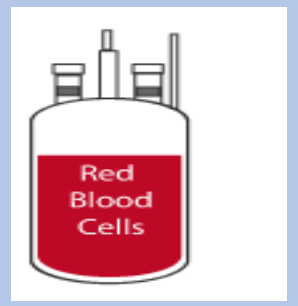
Plasma Component

- Fresh Frozen Plasma (FFP)
- Cryoprecipitate
- Cryosupernatant



Cellular Component

- Platelet concentrates
- Granulocyte concentrates



- Red cell concentrates

Preparation of Blood Components

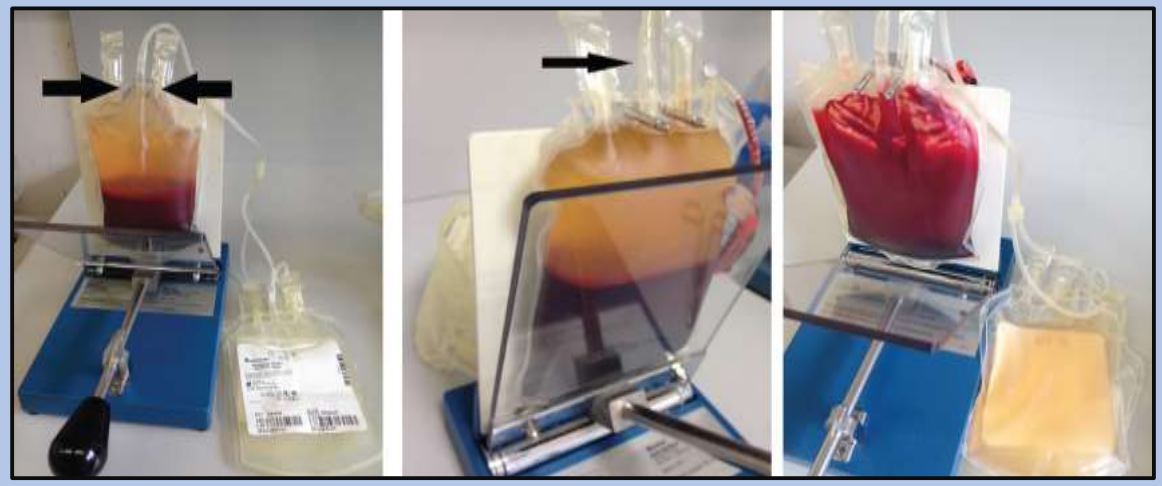
Methods of Preparation :

- ✓ Gravity separation
- ✓ Low and high speed refrigerated centrifugation
- ✓ Apheresis

→ Centrifugation is the first step of blood components preparation

→ Depends on 2 factors : - Speed of centrifugation

- Duration of centrifugation



1. **<u>Soft spin</u>**

4170 /g /2 min = platelet rich plasma

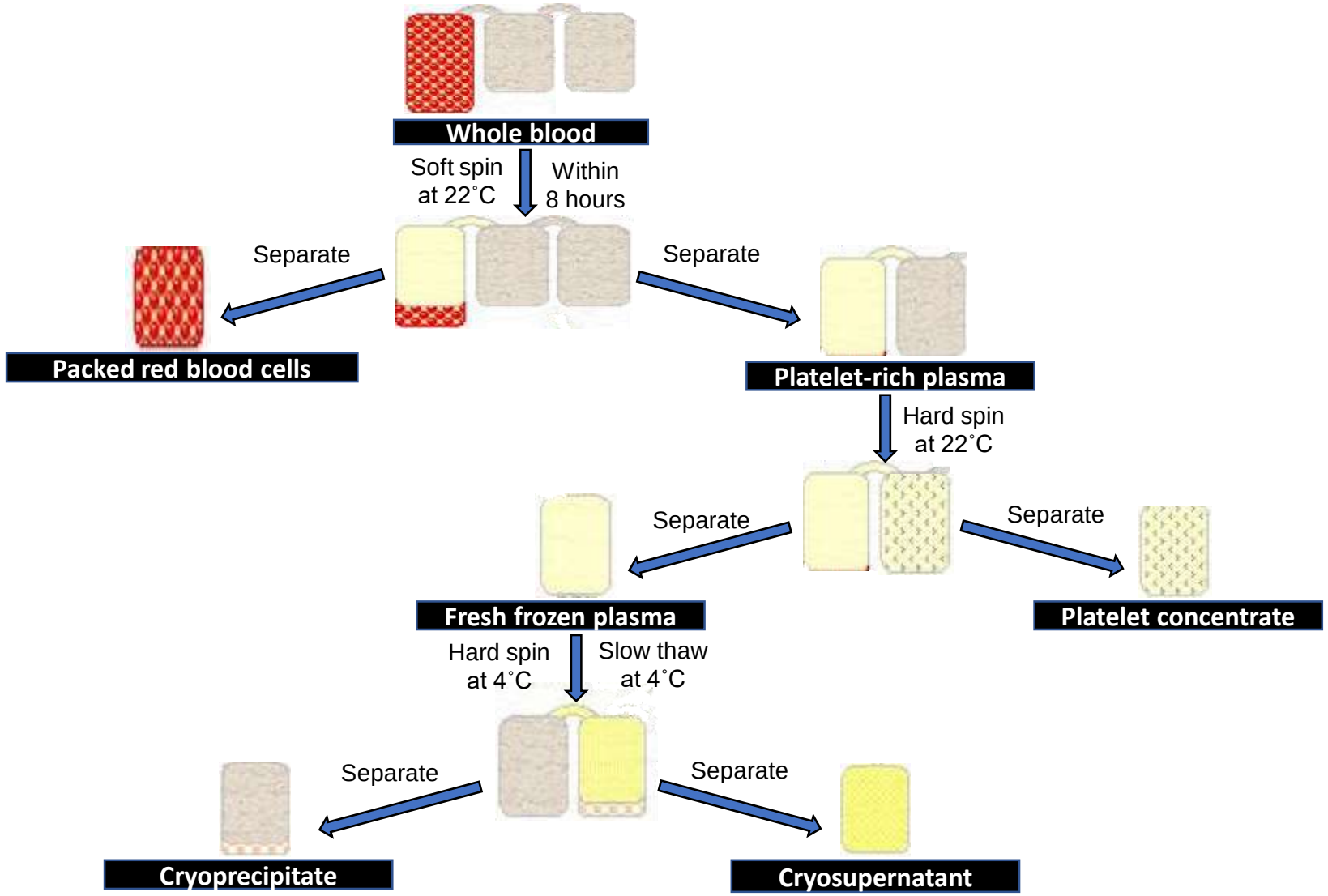
2. **<u>Hard spin</u>**

5000 /g /7 min = leukocyte-poor RBC, or cell free plasma

5000 /g /5 min = packed cell and platelet concentrate

4170 /g /10 min = cryoprecipitate

Preparation of Blood Components



WHOLE BLOOD

- Contain RBCs and plasma clotting factors
- Once whole blood has been stored at 2-6˚C for 24 hours, platelet function is lost
- By day 21 of storage, Factor V and VIII lose 5% to 30% of their activity

- **Storage :** 2-6˚C

- **Shelf life :** - Citrate-Phosphate-Dextrose (CPD) → 21 days
  - CPDA (Adenine) → 35 days

- **Indications :** - Acute blood loss with hypovolaemia
  - Exchange transfusion : → severe anaemia at birth
    → severe hyperbilirubinaemia
  - Massive transfusion
  - Cardiovascular bypass surgery

- Must be ABO & Rh compatible, crossmatch compatible

PACKED RED BLOOD CELLS

- To restore the oxygen-carrying capacity of blood and to maintain satisfactory tissue oxygenation
- Obtained by removal of supernatant plasma (platelet + plasma) from centrifuged whole blood
- The component of choice to increase haemoglobin:
  →I unit can increase Hb by about 1 g/dL & Hct by about 3%
- **Storage :** 2 - 4°C
- **Shelf life :** - CPDA (Adenine) → 35 days
  - SAGM (Saline, Adenine, Glucose and Mannitol) → 42 days
- **Indications :** - Symptomatic anaemia without clotting factor defects
  - Thalassemia
  - Sickle cell disease
- Must be ABO & Rh compatible, crossmatch compatible

PLATELET CONCENTRATE

- To prevent or treat bleeding in people with either low platelet count or poor platelet function. Often occurs in people receiving cancer chemotherapy
- Preparation of platelet concentrate :

  1) Random donor platelet (RDP)→ Prepared from whole blood

  2) Single donor platelet (SDP) → Made from single donor

  → Prepared by apheresis

- **Storage :** 22°C on agitator
- **Shelf life :** 5 days
- **Indications :** - Thrombocytopenia or have disordered platelet function
  - Actively bleeding (therapeutic use) or are at serious risk of bleeding (prophylactic use)
  - Heparin-induced thrombocytopenia, Thrombotic Thrombocytopenic Purpura (TTP)

PLATELET CONCENTRATE

- ABO & Rh compatible is preferred, crossmatch not necessary

Precautions

- Agitation during storage helps in :
  - → Exchange of gases
  - → Maintenance of pH
  - → Reduce formation of platelet aggregates

- pH should never fall below 6 because it can cause :
  - → Changes in shape of platelets from disc to sphere
  - → Pseudopod formation
  - → Release of platelet granules

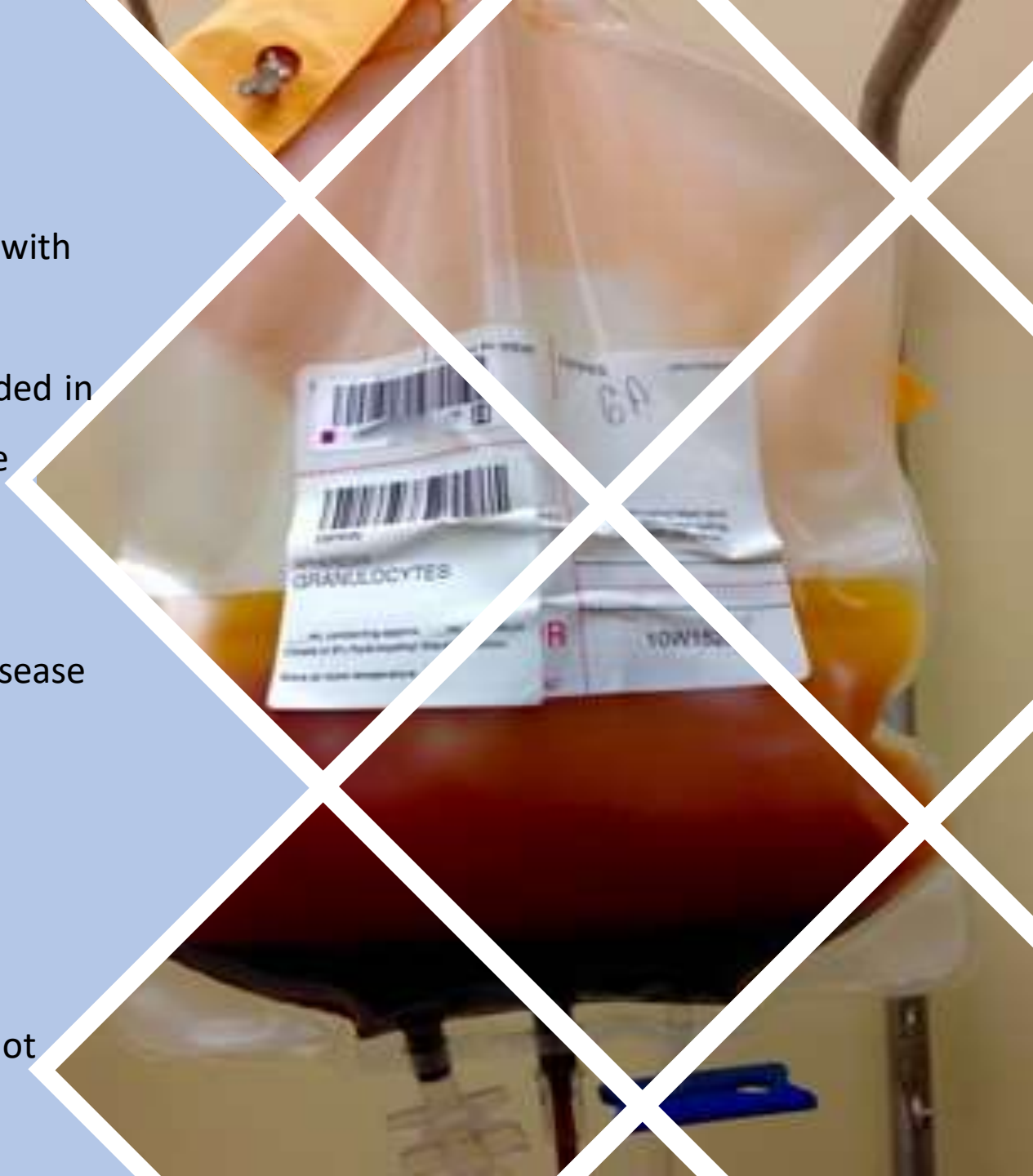
GRANULOCYTES CONCENTRATE

- To prevent and/or treat life-threatening infections in patients with severe febrile neutropenia and/or neutrophil dysfunction
- Obtained from a single donor using apheresis and are suspended in plasma containing various cells, including other types of white blood cells, red blood cells, and platelets
- May transmit Cytomegalovirus (CMV) infection and must be irradiated to eliminate the risk of causing Graft versus Host Disease (GvHD)

- **Storage :** 22°C

- **Shelf life :** 1 days

- **Indications** : - Severe neutropenia ($< 0.5 \times 10^9$ /L) who are not responding to antibiotic therapy



FRESH FROZEN PLASMA (FFP)

- As a replacement of coagulation factors and plasma protein
- Contain labile & non labile clotting factors, albumin and immunoglobulin
- **Storage :** -30°C
- **Shelf life :** 12 months
- **Indication :** - Single clotting factors deficiency
  - Multiple clotting factors deficiencies :
    1) Disseminated Intravascular Coagulation (DIC)
    2) Severe liver disease
    3) Warfarin overdose
    4) Thrombotic Thrombocytopenic Purpura (TTP)
- Must be ABO compatible

CRYOPRECIPITATE

- Cold precipitated proteins of plasma
- Contain about half of the Factor VIII and fibrinogen in the donated blood
- As a replacement therapy for Factor VIII, Factor XIII, von Willebrand factor (vWF) and Fibrinogen

- **Storage :** -30°C

- **Shelf life :** 12 months

- **Indications :** - Haemophilia A
  - Von Willebrand's disease
  - FXIII / fibrinogen deficiency
  - Correction of Factor VIII deficiency
  - Fibrinogen replacement in DIC

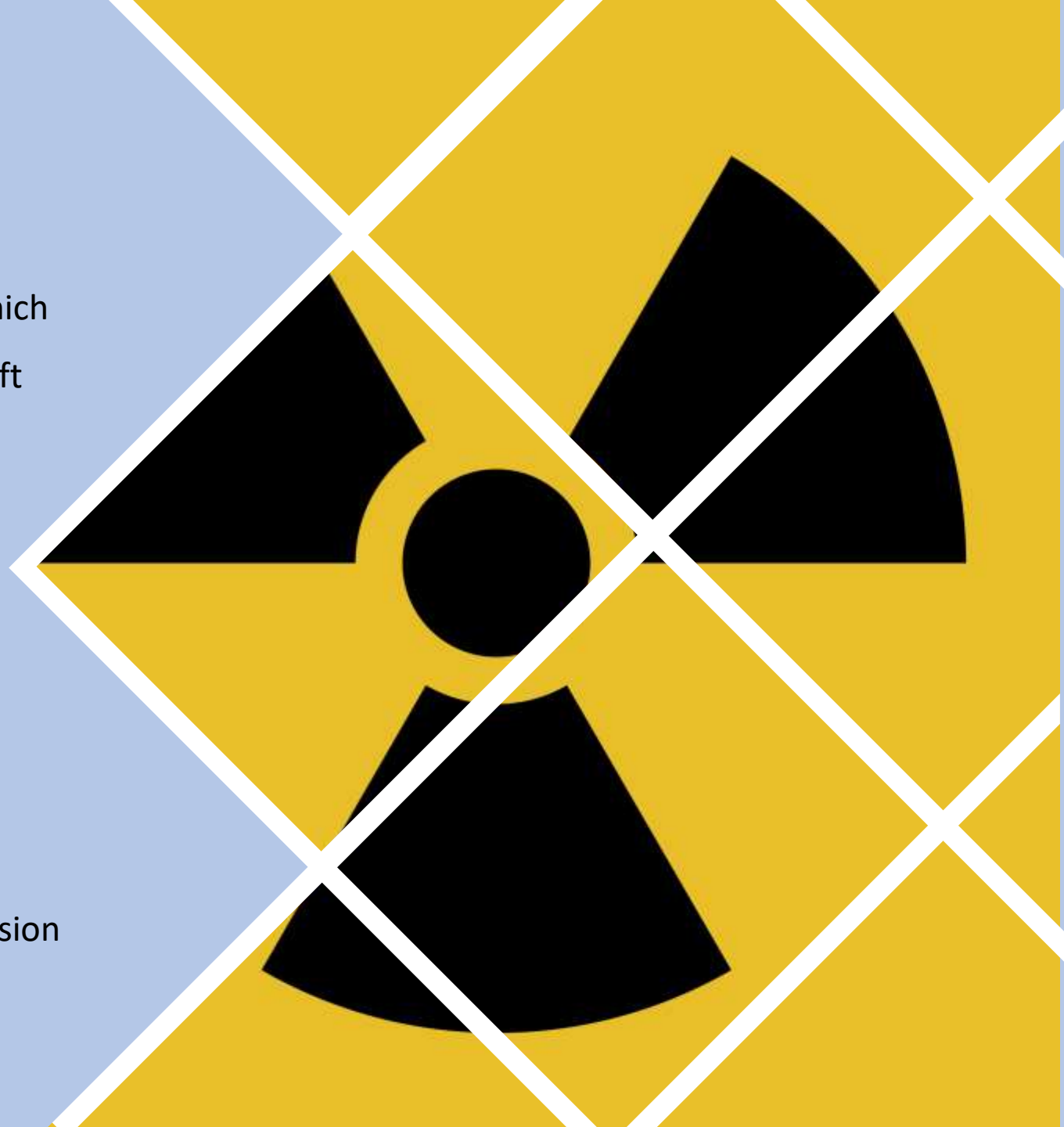
- ABO compatibility not required

CRYOSUPERNATANT / CRYO-POOR PLASMA

- It is by-product of cryoprecipitate preparation
- It contains adequate levels of the stable clotting factors II, VII, IX and X
- It lacks labile clotting factors VIII, V and fibrinogen
- **Storage :** -30°C
- **Shelf life :** 12 months
- **Indications :** - Plasma exchange in Thrombotic Thrombocytopenic Purpura/Haemolytic Uremic Syndrome (TTP/HUS)
  - In defeciency of stable clotting factors (e.g. coagulopathies due to warfarin drugs)

IRRADIATED BLOOD PRODUCTS

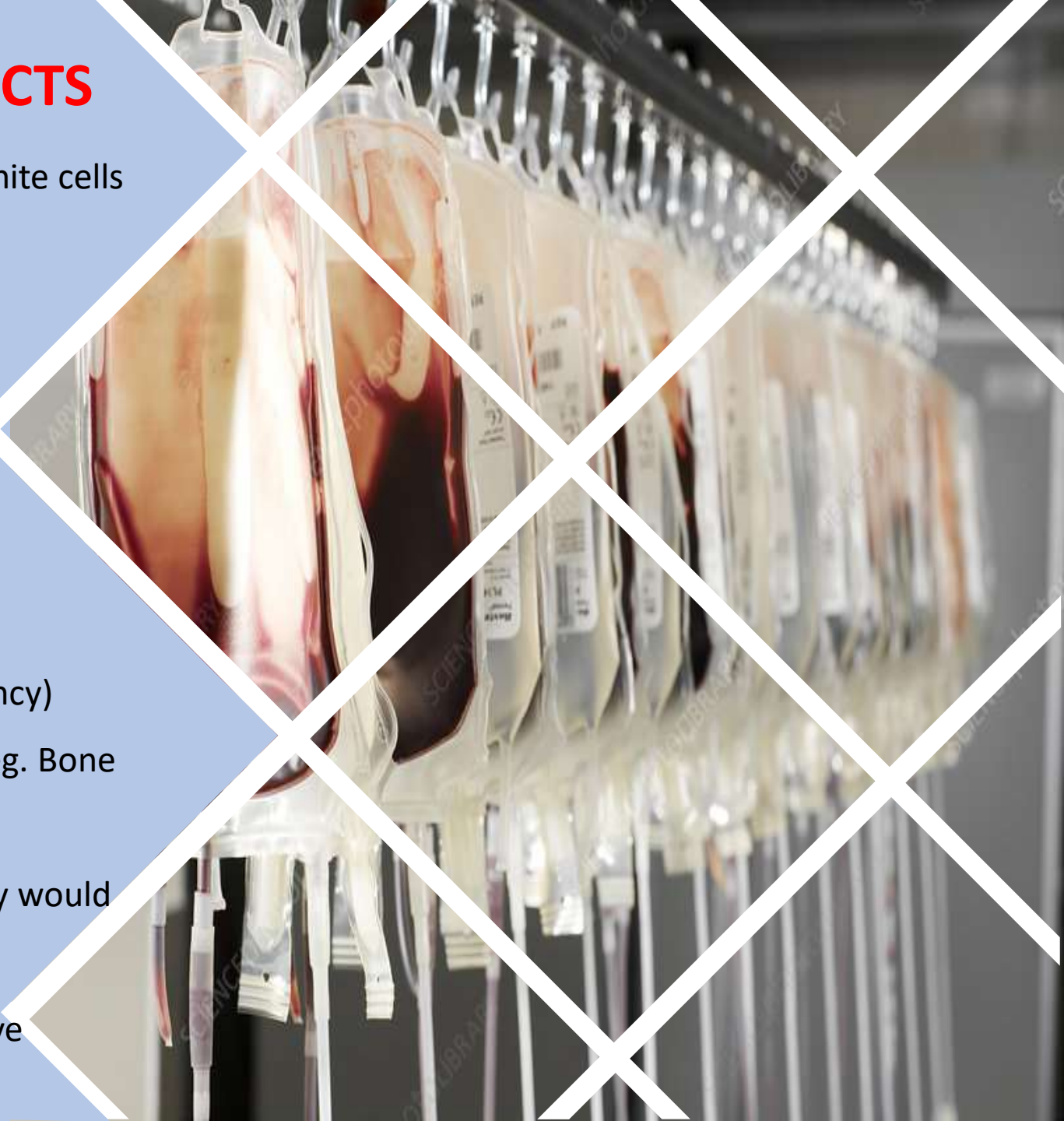
- Inactivate T-lymphocyte
- To prevent the proliferation of viable T lymphocytes which are the immediate cause of Transfusion Associated-Graft Versus Host Disease (TA-GVHD)
- **Shelf life :** 14 days (from date of irradiation)
- **Indications :** - Severely immunocompromised patient
  - Lymphoma patients
  - Stem cell / marrow transplants
  - Intrauterine transfusion
  - Neonates undergoing exchange transfusion
  - Hodgkin Disease
  - Units from close relatives



LEUCODEPLETED BLOOD PRODUCTS

- Blood products are filtered to remove the majority of white cells
- Contain < 5 x10^6 /L white cells per pack
- Performed soon after collection and prior to processing
- Reduces the incidence of febrile transfusion reactions and HLA alloimmunization
- Reduces the risk of the transmission of CMV infection

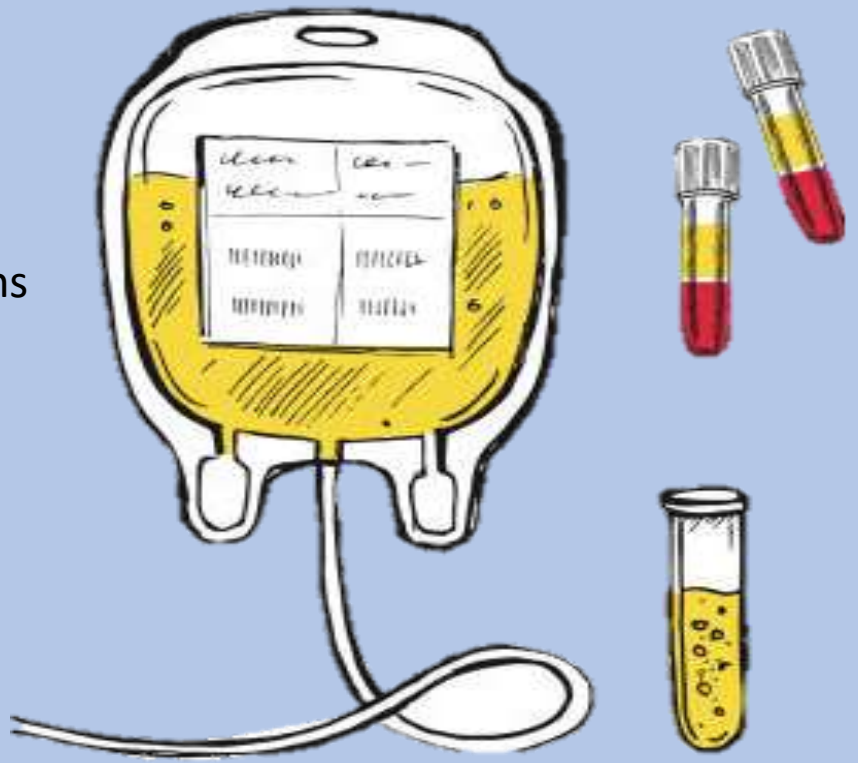
- **Indications :** - People at risk of febrile reaction (eg: those alloimmunised during pregnancy)
  - People at risk of severe CMV infection (eg. Bone marrow transplant recipients)
  - People in whom being platelet refractory would be problematic
  - People who are likely to receive a massive transfusion



PLASMA DERIVATIVES

- Are concentrates of specific plasma proteins prepared from pools (many donor units) of plasma
- Obtained through a process known as fractionation
- May be used to treat bleeding disorders
- Each specific plasma-derived product contains different clotting proteins
- Plasma derivatives include :

    1) Albumin
    2) Immunoglobulin
    3) Clotting factors



PROPER HANDLING OF BLOOD & BLOOD COMPONENTS

	Whole blood & Packed RBC	Platelet concentrate	Fresh frozen plasma & Cryosupernatant	Cryoprecipitate
Supply	After crossmatch	• Non group specific / compatible • Not require crossmatch	• Group specific / compatible • Not require crossmatch • Should be thawed at 37°C • Request only when required	• Group specific / compatible • Not require crossmatch • Should be thawed at 37°C and not stayed at this temperature once thawing completes • Request only when required
Collection	Blood box with ice	Blood box without ice	Blood box with ice	Blood box without ice
Use	As soon as possible	Transfuse immediately	Transfuse immediately	Transfuse immediately
Storage	2°C - 6°C blood fridge	Room temperature (20°C - 24°C) on agitator	2°C - 6°C blood fridge (after thawing)	Room temperature (20°C - 24°C) - after thawing

Thank you!