UNIT TERMINAL OBJECTIVE
5-9 At the completion of this unit, the paramedic student will be able to integrate the pathophysiological principles of the hematopoietic system to formulate a field impression and implement a treatment plan.

COGNITIVE OBJECTIVES
At the completion of this unit, the paramedic student will be able to:

5-9.1 Identify the anatomy of the hematopoietic system. (C-1)
5-9.2 Describe volume and volume-control related to the hematopoietic system. (C-1)
5-9.3 Identify and describe the blood-forming organs. (C-1)
5-9.4 Describe normal red blood cell (RBC) production, function and destruction. (C-1)
5-9.5 Explain the significance of the hematocrit with respect to red cell size and number. (C-1)
5-9.6 Explain the correlation of the RBC count, hematocrit and hemoglobin values. (C-1)
5-9.7 Define anemia. (C-1)
5-9.8 Describe normal white blood cell (WBC) production, function and destruction. (C-1)
5-9.9 Identify the characteristics of the inflammatory process. (C-1)
5-9.10 Identify the difference between cellular and humoral immunity. (C-1)
5-9.11 Identify alterations in immunologic response. (C-1)
5-9.12 Describe the number, normal function, types and life span of leukocytes. (C-1)
5-9.13 List the leukocyte disorders. (C-1)
5-9.14 Describe platelets with respect to normal function, life span and numbers. (C-1)
5-9.15 Describe the components of the hemostatic mechanism. (C-1)
5-9.16 Describe the function of coagulation factors, platelets and blood vessels necessary for normal coagulation. (C-1)
5-9.17 Describe the intrinsic and extrinsic clotting systems with respect to identification of factor deficiencies in each stage. (C-3)
5-9.18 Identify blood groups. (C-1)
5-9.19 Describe how acquired factor deficiencies may occur. (C-3)
5-9.20 Define fibrinolysis. (C-1)
5-9.21 Identify the components of physical assessment as they relate to the hematologic system. (C-1)
5-9.22 Describe the pathology and clinical manifestations and prognosis associated with: (C-3)
   a. Anemia
   b. Leukemia
   c. Lymphomas
   d. Polycythemia
   e. Disseminated intravascular coagulopathy
   f. Hemophilia
   g. Sickle cell disease
   h. Multiple myeloma
5-9.23 Integrate pathophysiological principles into the assessment of a patient with hematologic disease. (C-3)

AFFECTIVE OBJECTIVES
At the completion of this unit, the paramedic student will be able to:

5-9.24 Value the sense of urgency for initial assessment and interventions for patients with hematologic crises.

PSYCHOMOTOR OBJECTIVES
At the completion of this unit, the paramedic student will be able to:

5-9.25 Perform an assessment of the patient with hematologic disorder. (P-1)
DEclarative

I. Introduction
   A. Epidemiology
      1. Incidence
         a. Prevalence of hematologic disorders
         b. Supportive statistics
         c. Prevalence of warning signs and symptoms
      2. Morbidity/ mortality
         a. Reduced with early recognition
         b. Reduced with early access to EMS system
      3. Risk factors
      4. Prevention strategies
   B. Anatomy and physiology review
      1. Blood
         a. Components
         b. Color, specific gravity, pH
         c. Function
         d. Volume and volume control
      2. Plasma
         a. Components
         b. Color
         c. Function
         d. Volume control
      3. Blood-forming organs
         a. Bone marrow
         b. Liver
         c. Spleen
      4. Normal red cell production, function and destruction
         a. Erythrocytes
         b. Hemoglobin
         c. Production stimulus
         d. Destruction
      5. Normal white cell production and function
      6. The inflammatory process
      7. Immunity
         a. Cellular immunity
         b. Humoral immunity
         c. Autoimmune diseases
         d. Alterations in immunologic response
      8. Blood groups
      9. Hemostasis
         a. Vascular components
         b. Coagulation mechanisms
            (1) Intrinsic and extrinsic pathways

II. General pathophysiology, assessment and management
   A. Pathophysiology
   B. Assessment of the hematopoietic system
      1. General signs and symptoms
2. Specific signs and symptoms
   a. Vital signs
   b. Laboratory values

C. Focused history
   1. SAMPLE
   2. Chief complaint
   3. Pertinent past history
   4. Related signs and symptoms

D. Detailed physical examination
   1. Levels of consciousness
      a. Vertigo
      b. Fatigue
      c. Syncopal episode(s)
   2. Skin
      a. Prolonged bleeding
      b. Bruising
      c. Itching
      d. Pallor
      e. Jaundice
   3. Visual disturbances
   4. Gastrointestinal
      a. Epistaxis
      b. Bleeding gums
      c. Infections of the gums
      d. Ulcerations
      e. Melena
      f. Liver disease
      g. Pain
   5. Skeletal
      a. Arthralgia
      b. Nuchal rigidity
   6. Cardiorespiratory
      a. Dyspnea
      b. Chest pain
      c. Hemoptysis
      d. Tachycardia
   7. Genitourinary
      a. Hematuria
      b. Menorrhagia
      c. Infections

E. Management
   1. Airway and ventilation
      a. Oxygen
   2. Circulation
      a. Fluid volume replacement
      b. Manage dysrhythmias
   3. Pharmacological
      a. Oxygen
      b. Platelet aggregate inhibitor
      c. Alkalinizing agents
d. Narcotic/analgesic

4. Non-pharmacological

5. Transport considerations
   a. Appropriate mode
   b. Appropriate facility

6. Psychological/communication strategies

III. Specific illnesses/injuries

A. Anemia

1. Epidemiology
   a. Reduction below normal levels of hemoglobin or erythrocytes and is a symptom of an underlying disease process

2. Pathophysiology
   a. Morbidity/mortality
      (1) Can be self-limiting disease
      (2) Must be confirmed by laboratory diagnosis
   b. Precipitating causes
      (1) Blood loss (acute or chronic)
      (2) Decreased production of erythrocytes
      (3) Increased destruction of erythrocytes
   c. Hemolytic
      (1) Hereditary
         (a) Sickle cell
         (b) Thalassemia
         (c) Glucose-6-phosphate dehydrogenase deficiency
      (2) Acquired
         (a) Immune
         (b) Drug

3. Initial assessment findings
   a. Airway/breathing
      (1) Labored breathing may or may not be present
   b. Circulation
      (1) Peripheral pulses
         (a) Quality
         (b) Rhythm
      (2) Changes in skin
         (a) Color
         (b) Temperature
         (c) Moisture

4. Focused history
   a. Complaints
      (1) Complaints secondary to anemia
         (a) Fatigue
         (b) Lethargy
         (c) Hypoxia
         (d) Dyspnea
      (2) Complaints secondary to leukopenia
         (a) Infections
         (b) Fevers
5. Detailed physical exam
   a. Airway
   b. Breathing
   c. Circulation
      (1) Alterations in heart rate and rhythm may occur
      (2) Peripheral pulses
      (3) Blood pressure
      (4) ECG findings
         (a) Arrhythmias and ectopy

6. Management
   a. Airway and ventilation
   b. Circulatory support
   c. Pharmacological
      (1) Analgesics
      (2) Fluid volume replacement
      (3) Control of bleeding
   d. Non-pharmacological
      (1) Position of comfort
   e. Transport considerations
      (1) Appropriate mode
         (a) Indications for rapid transport
            i) Significant changes in LOC
            ii) Hypotension/ hypoperfusion
      (2) Appropriate facility
   f. Support and communication strategies
      (1) Explanation for patient, family, significant others
      (2) Communications and transfer of data to the physician

B. Leukemia
1. Epidemiology
2. Pathophysiology
   a. Morbidity/ mortality
      (1) Blood loss
      (2) Death
   b. Neoplastic disease
      (1) Acute versus chronic
   c. Precipitating causes
      (1) Radiation exposure
      (2) Viral infections
      (3) Chemicals
      (4) Immune defects
      (5) Chromosomal changes
3. Initial assessment findings
   a. Levels of consciousness
   b. Airway/ breathing
      (1) Labored breathing may or may not be present
   c. Circulation
      (1) Peripheral pulses
(a) Quality
(b) Tachycardia
(2) Changes in skin
(a) Color
(b) Temperature
(c) Moisture

4. Focused history
   a. Complaints
      (1) Fatigue, bone pain, diaphoresis
      (2) Elevated body temperature
      (3) Sternal tenderness
      (4) Heat intolerance
      (5) Abdominal fullness
      (6) Bleeding
   b. Contributing history
      (1) Recurrent bleeding
      (2) Increasing frequency and/or duration

5. Detailed physical exam
   a. Airway
   b. Breath sounds
   c. Circulation
      (1) Skin
      (2) Blood pressure may be low
      (3) ECG findings
         (a) Tachycardia
         (b) Ectopic

6. Management
   a. Position of comfort
   b. Pharmacological
      (1) Analgesia
      (2) Increase or decrease heart rate
      (3) Fluid volume replacement
   c. Electrical
      (1) Constant ECG monitoring
   d. Transport
      (1) Criteria for rapid transport
         (a) No relief with medications
            i) Hypotension/hypoperfusion
            ii) Significant changes in ECG
      (2) Indications for no transport
         (a) Refusal
         (b) Referral
   e. Support and communication strategies
      (a) Explanation for patient, family, significant others
      (b) Communications and transfer of data to the physician

C. Lymphomas
   1. Epidemiology
      a. Hyperplasia of the lymphoreticular system
   2. Pathophysiology
      a. Morbidity/mortality
3. Initial assessment findings
   a. Levels of consciousness
   b. Airway/ breathing
   c. Circulation
4. Focused history
   a. Complaints
      (1) Fever
      (2) Night sweats
      (3) Generalized pruritus
      (4) Anorexia
      (5) Weight loss
      (6) Fatigue, bone pain, diaphoresis
5. Detailed physical exam
   a. Airway
   b. Breath sounds
      (1) May be clear to auscultation
      (2) Congestion in bases may be present
   c. Circulation
      (1) Skin
         (a) Pallor during the episode
         (b) Temperature may vary
         (c) Diaphoresis is usually present
      (2) Blood pressure may low
      (3) ECG findings
         (a) Tachycardia
         (b) Ectopic
6. Management
   a. Position of comfort
   b. Pharmacological
      (1) Analgesia
      (2) Increase or decrease heart rate
      (3) Fluid volume replacement
   c. Electrical
      (1) Constant ECG monitoring
   d. Transport
      (1) Criteria for rapid transport
         (a) No relief with medications
            i) Hypotension/ hypoperfusion
            ii) Significant changes in ECG
      (2) Indications for no transport
         (a) Refusal
         (b) Referral
   e. Support and communication strategies
      (a) Explanation for patient, family, significant others
      (b) Communications and transfer of data to the physician
D. Polycythemia
1. Epidemiology
a. Overabundant production of red blood cells, white blood cells and platelets
b. Rare disorder seen in persons over 50 years of age

2. Pathophysiology
   a. Morbidity/ mortality
      (1) Thrombosis
      (2) Death from thrombosis

3. Initial assessment findings
   a. Levels of consciousness
   b. Airway/ breathing
      (1) Labored breathing is common
   c. Circulation
      (1) Peripheral pulses
         (a) Quality
         (b) Tachycardia
      (2) Changes in skin
         (a) Color - red-purple complexion
         (b) Red hands and feet
         (c) Pruritic

4. Focused history
   a. Complaints
      (1) Dyspnea
      (2) Generalized pruritus

5. Detailed physical exam
   a. Airway
   b. Breath sounds
   c. Circulation
      (1) Skin
         (a) As above
         (b) Temperature may vary
      (2) ECG findings
         (a) Tachycardia

6. Management
   a. Position of comfort
   b. Pharmacological
      (1) Analgesia
      (2) Increase or decrease heart rate
   c. Non-pharmacological
      (1) Phlebotomy
   d. Transport for
      (1) Indications for no transport
         (a) Refusal
         (b) Referral
   e. Support and communication strategies
      (a) Explanation for patient, family, significant others
      (b) Communications and transfer of data to the physician

E. Disseminated intravascular coagulopathy
   1. Epidemiology
      a. A complication of severe injury, trauma or disease; acute bleeding disorder resulting from defibrination
      b. First phase characterized by free thrombin in the blood, fibrin deposits and
aggregation of platelets

c. Phase two is hemorrhage caused by depletion of clotting factors

2. Pathophysiology
   a. Morbidity/ mortality
      (1) Uncontrolled bleeding
      (2) Shock
      (3) Death

3. Initial assessment findings
   a. Level of consciousness
   b. Airway/ breathing
      (1) Labored breathing is common
   c. Circulation
      (1) Peripheral pulses
         (a) Weak and thready
      (2) Tachycardia
   d. Changes in skin
      (1) Pallor
      (2) Purpura over chest and abdomen
      (3) Cool, clammy
      (4) Bleeding
      (5) Hypotension/ hypoperfusion

4. Focused history
   a. Complaints
      (1) Dyspnea
      (2) Bleeding

5. Detailed physical exam
   a. Airway
   b. Breath sounds
      (1) May be clear to auscultation
      (2) Congestion in bases may be present
   c. Circulation
      (1) Skin
         (a) As above
         (b) Temperature may vary
      (2) ECG findings
         (a) Tachycardia
         (b) Ectopic

6. Management
   a. Position of comfort
   b. Pharmacological
      (1) Analgesia
      (2) Increase or decrease heart rate
      (3) Fluid volume replacement
   c. Support and communication strategies
      (a) Explanation for patient, family, significant others
      (b) Communications and transfer of data to the physician

F. Hemophilia
1. Epidemiology
   a. A hereditary disorder transmitted by the female to the male
   b. In true hemophilia A factor VIII is nearly absent
c. In hemophilia B there is a deficiency in factor IX
d. The ability to produce thrombin is severely impaired by deficiency or absence of these factors

2. Pathophysiology
   a. Morbidity/ mortality
      (1) Uncontrolled bleeding
      (2) Shock
      (3) Death

3. Initial assessment findings
   a. Levels of consciousness
   b. Airway/ breathing
      (1) Labored breathing is common
   c. Circulation
      (1) Peripheral pulses
         (a) Weak and thready
      (2) Tachycardia
   d. Changes in skin
      (1) Pallor
      (2) Cool, clammy
      (3) Bleeding
         (a) From body orifices
         (b) Knees
         (c) Wrists
         (d) Elbows
         (e) Hematuria
         (f) Epistaxis
         (g) Hemoptyysis
         (h) Hematemesis
         (i) Melena
      (4) Hypotension/ hypoperfusion

4. Focused history
   a. Complaints
      (1) Dyspnea
      (2) Bleeding

5. Detailed physical exam
   a. Airway
   b. Breath sounds
      (1) May be clear to auscultation
      (2) Congestion in bases may be present
   c. Circulation
      (1) ECG findings
      (2) Tachycardia
      (3) Ectopy
   d. Skin
      (1) As above
      (2) Temperature may vary

6. Management
   a. Position of comfort
   b. Pharmacological
      (1) Analgesia
G. Sickle cell disease

1. Epidemiology
   a. Highest incidence in blacks, Puerto Ricans and persons of Spanish, French, Italian, Greek and Turkish origin

2. Pathophysiology
   a. A congenital hemolytic anemia
   b. A chemical defect within the hemoglobin of red blood cells
   c. Morbidity/ mortality
      (1) Sepsis
      (2) Shock
      (3) Death

3. Initial assessment findings
   a. Levels of consciousness
   b. Airway/ breathing
   c. Circulation
      (1) Peripheral pulses
      (2) Changes in skin
         (a) Pallor
         (b) Cool; clammy
      (3) Hypotension/ hypoperfusion

4. Focused history
   a. Chief complaint
      (1) Sudden onset develops into a condition called “crisis”
         (a) Thrombotic crisis (painful)
         (b) Aplastic
         (c) Hemolytic

5. Detailed physical exam
   a. Airway
   b. Breath sounds
   c. Circulation
      (1) Skin
         (a) As above
         (b) Temperature may vary
      (2) ECG findings
         (a) Tachycardia
         (b) Ectopy
   d. Increased weakness
   e. Aching
   f. Chest pain
   g. Sudden, severe abdominal pain
   h. Bony deformities
   i. Icteric sclera
   j. Abdominal pain
k. Fever
l. Arthralgia

6. Management
a. Position of comfort
b. Pharmacological
   (1) Analgesia
   (2) Fluid volume replacement
c. Transport for reperfusion
   (1) Indications for no transport
      (a) Refusal
d. Support and communication strategies
   (a) Explanation for patient, family, significant others
   (b) Communications and transfer of data to the physician

H. Multiple myeloma
1. Epidemiology
   a. A plasma cell dyscrasia characterized by neoplastic cells that infiltrate bone marrow
   b. Eventually plasma cells become malignant leading to tumor formation within the bone
2. Pathophysiology
   a. Morbidity/ mortality
      (1) Fractures
      (2) Bleeding
      (3) Shock
      (4) Death
3. Initial assessment findings
   a. Levels of consciousness
   b. Airway/ breathing
      (1) Labored breathing is common
   c. Circulation
      (1) Peripheral pulses
         (a) Weak and thready
         (b) Tachycardia
      (2) Changes in skin
         (a) Pallor
         (b) Cool, clammy
      (3) Bleeding
      (4) Hypotension/ hypoperfusion
4. Focused history
   a. Complaints
      (1) Weakness
      (2) Skeletal pain
      (3) Hemorrhage
      (4) Hematuria
      (5) Lethargy
      (6) Weight loss
      (7) Frequent fractures
5. Detailed physical exam
   a. Airway
   b. Breath sounds
c. Circulation
   (1) Skin
      (a) As above
      (b) Temperature may vary
   (2) ECG findings
      (a) Tachycardia
      (b) Ectopy
d. Increased weakness
e. Aching
f. Chest pain
g. Sudden severe abdominal pain
h. Bony deformities
i. Arthralgia

6. Management
   a. Position of comfort
   b. Pharmacological
      (1) Analgesia
      (2) Fluid volume replacement
c. Transport for reperfusion
   (1) Indications for no transport
      (a) Refusal
d. Support and communication strategies
      (a) Explanation for patient, family, significant others
      (b) Communications and transfer of data to the physician

IV. Integration
   A. Apply pathophysiological principles and the assessment findings to a patient with a hematologic disorder
   B. Formulation of field impression - decisions based on
      1. Initial assessment
      2. Focused history
      3. Detailed physical examination
   C. Develop and execute a patient management plan based on field impression
      1. Initial management
         a. Airway support
         b. Ventilation support
         c. Circulation support
         d. Non-pharmacological
         e. Pharmacological
      2. On-going assessment
      3. Transport criteria
         a. Appropriate mode
         b. Appropriate facility
      4. Non-transport criteria
      5. Advocacy
      6. Communications
      7. Prevention
      8. Documentation
      9. Quality assurance