2.02 Understand the functions and disorders of the circulatory system
2.02 Understand the functions and disorders of the circulatory system

Essential questions:
- What are the functions of blood?
- What are some disorders of the blood?
- How are blood disorders treated?
- How do you relate the body’s use of nutrients to the blood?
- What are the functions of the circulatory system?
- What are some disorders of the circulatory system?
- How are disorders of the circulatory system treated?
- How do you relate the body’s use of nutrients to the circulatory system?
What are the functions of blood?

Transportation

What does the blood transport?
- Oxygen from the lungs, nutrients and fat cells from the digestive system, and hormones from the endocrine glands.
What are the functions of blood?

Regulation

- How does the blood regulate heat? It absorbs the heat generated by skeletal muscles.

- How does the blood regulate acid/base balance? It ensures that the pH and electrolyte values are within normal parameters for proper cell functioning.
What are the functions of blood?

Protection

- Protects from invasion and infection by pathogens and toxins.
- This is done by special WBC’s and special proteins called antibodies.
- What is the relevance to health?
Functions of the blood components

- Plasma
- Erythrocytes
- Leukocytes
- Thrombocytes
**Erythrocytes**

- What are the functions of erythrocytes?
  - Carry oxygen to every living cell
  - Carry carbon dioxide away
  - The most abundant cells in the blood

- What is the function of hemoglobin?
  - O2 and Co2 attach to hemoglobin molecules of the RBC
  - Thus known as the binding site.
Erythrocytes

- **hemolysis**
  - It is the rupture of RBC’s
  - Occurs when the RBC approaches the end of their 120 day life span
  - It can also result from diseases of the RBC’s
  - Old erythrocytes are removed by the liver and spleen
Rh factor

Rh factor is the second antigen located on the red blood cell.

It is named after the rhesus monkey.

Not everyone possesses this factor.

- If you have this antigen, you are considered Rh positive.
- If you do not, you are considered Rh negative.
Hemolytic anemia

- **Hemolytic anemia:**
  - When RBC’s are destroyed and removed from the blood stream before their normal life span is over.

- **How is it treated?**
  - Blood transfusions, medicines, bone marrow transplants, lifestyle changes.
Leukocytes

- **Functions**: Guardians from invasion and infection.
  - 1 WBC to 700 RBC’s
  - Can leave the blood, but RBC’s cannot.
- **Diapedesis**: The process of WBC’s slipping through the capillary walls to infection sites in the body tissues.
Leukocytes

- **Agranulocytes**
  - **Lymphocytes** - 2nd most abundant WBC. Important role in the immune response by forming antibodies to fight antigens
  - **Monocytes** - the largest WBC. Produced in the red bone marrow, remain in the blood for 1-3 days before migrating to the body tissues
Leukocytes

Granulocytes

- Neutrophils
  - most abundant
  - the most important because they are the first responder
  - **Phagocytes:** cells that engulf and kill foreign invaders such as bacteria, viruses and fungi.

- Eosinophils:
  - small portion of our WBC count
  - participate in inflammatory processes, including allergic reactions.
  - capable of phagocytosis

- Basophils
  - least abundant
  - produce histamine which induces an inflammatory response and summon more infection-fighting WBC’s to the infection
  - produce heparin, and anticoagulant to prevent blood clotting
Inflammation

- **Inflammation**: a response by vascular tissues to pathogens, damaged cells or other irritants.

- **Characterized by**:
  - redness at the site
  - swelling
  - pain
  - heat
Inflammation

2.02 Understand the functions and disorders of the circulatory system
Thrombocytes

- Also known as blood platelets
  - smallest of the formed elements

**Functions:**

- responsible for clotting
- release a substance called serotonin that can cause smooth muscle constriction and decreased blood flow.
2.02 Understand the functions and disorders of the circulatory system

Thrombocytes
Blood types

- **Compare blood types.** (antigen/antibodies)

- A
- B
- AB
- O

Who can receive type O blood?
Rh factor

What is erythroblastosis fetalis?
- A hemolytic disease of the newborn
- Can be fatal

How can it be treated?
- The mother is given an immune serum called RhoGAM after giving birth to her first child
Blood Disorders

- Anemia
  - A blood condition in which there are below normal amounts of RBC’s or deficient hemoglobin.
  Discuss why these symptoms occur.
Blood disorders

Thrombus: blood clot

Embolus: a moving blood thrombus.
Blood disorders

Hematoma: Swollen area that appears as purple, yellow, or greenish splotches in the tissue just under the skin.

Contusion: a bruise
Blood disorders

Hemophilia

• Hemophilia: A hereditary condition that prohibits or slows down the ability to clot.
  • Transmitted from mother to son because of a missing clotting factor.
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Blood disorders

- **Leukemia**
  - Cancer of the blood
  - Unknown cause.

- **Symptoms:**
  - Headache, fatigue, dyspnea, sore throat, swollen lymph nodes, anemia.

- **Treatment:**
  - Chemotherapy, radiation therapy, stem cell transplant
Blood disorders

- Multiple myeloma
  - Cancer of the plasma cells in the bone marrow

- Symptoms:
  - Bone fractures, bone pain, particularly in the back and ribs.

- Treatment:
  - Treatable but not curable. Steroid drugs, chemotherapy and stem cell transplants
Blood disorders

- **Polycythemia**
  A condition in which the bone marrow manufactures too many red blood cells.

**Symptoms:**
- Blood thickens, increased chance of blood clot formation.

**Treatment:**
- Draw blood. This reduces the number of RBC’s circulating in the body.
Blood disorders

- **Septicemia**
  - Blood poisoning. A condition in which a pathogen is present in the blood.

**Symptoms:**
- Fever, chills, tachypnea, tachycardia, skin lesions, mental status changes.

**Treatment:**
- Oxygen, antibiotics.
- Prognosis poor.
Blood disorders

- **Sickle cell anemia**
  - RBC’s shaped like a crescent or sickle

**Symptoms:**
- Excruciating painful episodes called crises. Pain in the back and around long bones. RBC’s may become lodged in small vessels in the brain.

**Treatment:**
- Antibiotics, folic acid, blood transfusion, pain meds fluids.
What are the functions of the heart?
Functions of the heart

Did you know?

At rest, 2 ounces of blood is circulated with each heart beat.
Functions of the heart

It’s a PUMP

What do pumps do?

How does this relate to heart function?
2.02 Understand the functions and disorders of the circulatory system

Hear the beat!

https://www.youtube.com/watch?v=-4kGMI-qQ3I
Blood Pressure

Blood pressure is the surge of blood when heart pumps creates pressure against the walls of the arteries.

- **SYSTOLIC PRESSURE**
  - Measured during the contraction phase

- **DIASTOLIC PRESSURE**
  - Measured when the ventricles are relaxed

- Normal range for an adult: < 120/80
Functions of the heart

It’s a PUMP

What makes the pump work?

It’s electric!

Explain the electrical activity of the heart.
It’s electric!

Discuss the function of the heart’s conduction system.

2.02 Understand the functions and disorders of the circulatory system
Electrocardiogram

- **EKG or ECG**
- **SYSTOLE** = contraction phase
- **DIASTOLE** = relaxation phase

Baseline of an EKG is a flat line:
- **P** = Atrial contraction
- **QRS** = Ventricular contraction
- **T** = Ventricular relaxation
Functions of the heart

- 2 separate pumps working together
- Pumps blood to the body (left side)
- Pumps blood to the lungs to pick up O2 and rid blood of Co2 (right side)
2.02 Understand the functions and disorders of the circulatory system

Systemic circulation is the process of the left ventricle pumping the blood through the body and back to the right atrium.
The transportation process

Right side
Superior vena cava
Inferior vena cava
Right atrium
Tricuspid valve
Right Ventricle
Pulmonary valve
Pulmonary artery

Left Side
Pulmonary vein
Left atrium
Bicuspid valve
Left ventricle
Aortic valve
Aorta
Body

Lungs CO2 and O2 exchange

(Schematic of systemic circulation)
The transportation process

- **Pulmonary Circulation:**
  - The right ventricle pumps the blood through the vasculature of the lungs and back to the heart.
2.02 Understand the functions and disorders of the circulatory system

- **ARTERIES**
  - Arteries carry oxygenated blood away from the heart.
Vessels of the circulatory system

2.02 Understand the functions and disorders of the circulatory system
Vessels of the circulatory system

■ VEINS

- Deoxygenated blood returning to the heart is carried by veins.
Vessels of the circulatory system

Veins
Capillaries

Function:
- Exchange of nutrients, gases and waste products occurs here.
- They are transition vessels where blood begins the trip back to the heart.
Remember Pulse Sites?

- Where do they come from?

- Brachial
- Temporal
- Radial
- Ulnar
- Carotid
- Facial
- Femoral
- Popliteal
- tibialis
dorsalis pedis
Aneurysm

- **Caused by:**
  - a weakened area of blood vessel wall.

- **Symptoms:**
  - pain, pulse changes

- **Treatment:**
  - if severe, surgical repair
Circulatory disorders

Angina pectoris

■ What is it?
  - chest pain or discomfort from inadequate flow of blood to the heart

■ Symptoms:
  - chest pain, radiating to the left shoulder, arm, neck and jaw. May have some nausea, diaphoresis and dyspnea.

■ Treatment:
  - nitroglycerin
  - oxygen
  - procedures to open up arteries
Circulatory disorders

■ Arrhythmia
  ■ Any change from normal heart rate or rhythm

■ BRADYCARDIA
  ■ Slow heart rate (<60 beats per minute)

■ TACHYCARDIA
  ■ Rapid heart rate (>100 beats per minute)
Circulatory disorders

Arteriosclerosis

■ What is it?
  ■ hardening of the arteries
  ■ Inner layer of vessel becomes thickened.
  ■ vessels are less flexible or even brittle

■ Symptoms:
  ■ Often none, but later may have increased blood pressure, angina.

■ Treatment
  ■ Improve diet, exercise, stop smoking, medications, surgical repair
Circulatory disorders

Atherosclerosis

- What is it?
  - Most common form of arteriosclerosis

- Caused by:
  - Potentially life threatening condition
  - Buildup of a yellow fat like substance called plaque on the inner lining of blood vessels
  - Can cause the blood to be restricted or blocked.
  - Can be caused by genes, improper diet, smoking, sedentary lifestyle
Circulatory disorders

Coronary artery disease

■ Cause:
  ■ Insufficient blood flow to heart tissue due to atherosclerosis or a clot in the coronary artery.

■ Symptoms:
  ■ Angina, nausea, sweating fainting

■ Treatment:
  ■ Same as Atherosclerosis
Circulatory disorders

Hypertension

- **What is it?**
  - High blood pressure.

- **Cause:**
  - Heredity, diet high in fat and salt intake, age, obesity, smoking, stress

- **Symptoms:**
  - Often not noticed until a heart attack or stroke occurs.

- **Treatment:**
  - change diet, weight loss, exercise, decrease alcohol intake, medications
Circulatory disorders

Heart failure
- **What is it?** A life threatening condition that is decreased pump efficiency usually with the left side of the heart.
- **Cause:**
  - Heart attack, cardiac infections, hypertension, valve disease
- **Symptoms:**
  - Edema of the legs, shortness of breath, pulmonary edema.
- **Treatment:**
  - oxygen, medications
- **Pulmonary edema:** When fluid forms in the lungs and causes difficulty breathing.
Circulatory disorders

Murmurs

- What is it?
  - An extra or unusual sound of the heartbeat

- Cause:
  - Blood leaking backward due to a faulty heart valve or narrowed valve opening.

- Symptoms:
  - Sometimes none, but may cause fatigue, palpitations, shortness of breath.

- Treatment:
  - Valve replacement (heart surgery) if severe
Circulatory disorders

- **Myocardial infarction**

  - Chest discomfort
  - Arm or back discomfort
  - Neck or jaw discomfort
  - Trouble breathing, with or without chest discomfort
  - Feeling light-headed or breaking into a cold sweat
  - Feeling sick or discomfort in your stomach
Myocardial Infarction

AKA heart attack

- **Cause:**
  - decreased blood flow to the heart tissue

- **Symptoms:**
  - indigestion, heavy crushing pain in the center of the chest radiating to the left arm and jaw, dyspnea, nausea, sweating.

- **Treatment:**
  - CPR if needed, oxygen, medications, surgery
Circulatory disorders

Peripheral vascular disease

■ What is it?
  ■ Any disease of the blood vessel outside the heart and brain.

■ Cause:
  ■ narrowing of the vessels that carry blood to the legs, arms, stomach or kidneys.

■ Symptoms:
  ■ pain, cramping, decreased blood flow to affected areas, sensitivity to cold temperatures, gangrene

■ Treatment:
  ■ treat the cause. May require surgery.
Circulatory disorders

Transient ischemic attack

- **What is it?**
- a mini stroke.
- Usually occurs before a major stroke.

Learn these signs of stroke.

**Face**
Does the face look uneven? Ask the person to smile.

**Arm**
Does one arm drift down? Ask the person to raise both arms.

**Speech**
Does their speech sound strange? Ask the person to repeat a simple phrase, for example, "The sky is blue."

**Time**
If you observe any of these signs, then it's time to call 9-1-1.

Call 9-1-1

Understand the functions and disorders of the circulatory system
Varicose veins

What is it?
- veins that become swollen, usually in the legs. They can also be found in the rectal area (hemorrhoids).

Cause:
- Hypertension, obesity, standing or sitting still for long periods, age, pregnancy.

Symptoms:
- cramps in the legs, pain in feet and ankles.

Treatment:
- Weight loss, physical movement, support hose, elevate legs, surgery.
Circulatory disorders

Leading Causes of Death: The Impact of Circulatory Disorders

- CVD: 41%
- Cancer: 29%
- Other: 29%
- HIV/AIDS: 2%
- Accidents: 4%
Relevance of nutrients to the blood and circulatory system

- The circulatory system plays a vital role in homeostasis
  - Absorption and transport of nutrients to cells, tissues, organs, and systems

Did you know???

- Vitamin K - prevents hemorrhage
- Vitamin B12 - prevents anemia
- Vitamin E - prevents hemolysis