3.1 - The Body’s Transport System
The Cardiovascular System

- Our bodies have **highways** in them, **linking** all the parts of our body – this is the cardiovascular system (aka circulatory system)
  - Consists of **blood**, blood vessels, and the heart
- This system carries **needed** substance to cells and carries waste products **away** from cells
Delivering Needed Materials

- Substances that need to get from one part of the body to another are carried by **blood**
  - **Oxygen** is carried from your lungs to your other body **cells**
  - Glucose is transported by **blood** to your cells to produce **energy**
Removing Waste Products

- The cardiovascular system takes away waste from cells
- When our cells break down glucose to create energy they produce carbon dioxide which is a waste product – this is carried away by your blood
Fighting Disease

- Your cardiovascular system helps to **attack** disease-causing microorganisms.
- **Prevents** you from getting sick, but if you do get sick the **disease-fighting** cells will kill them to help you get better.
The Heart

- Your heart is a **hollow, muscular** organ that pumps blood throughout the body
  - Your heart (about the size of your **fist**) is in the **center** of your chest
  - It is behind your **sternum** (breastbone) and inside the **rib cage**
  - It is made of **cardiac** muscle which can contract over and over without **getting tired**
The Heart – Blood Flow

Every second of your life, your heart pumps blood through your body. In a year, the heart pumps enough blood to fill more than 30 competition-size swimming pools.
The Heart’s Structure

- There is a **right** side and a **left** side to your heart.
- The right side is completely separated by a wall of tissue called the **septum**. Each side has two compartments, or **chambers** – an upper and a lower.
  - The upper chambers, called an **atrium**, receive blood that comes **into** the heart.
  - The lower chambers, **ventricle**, pumps blood **out of** the heart.
  - These chambers are separated by **valves** – a flap of tissue that prevents blood from flowing **backwards**.
How the Heart Works

- The heart has **two** phases – one where the heart **relaxes** and another when it **contracts**
  - When the heart relaxes it **fills** up with **blood**
  - When it contracts it pumps blood **forward**
  - This is the **sound** we hear when listening to a heart
- When **relaxed**, blood moves **into** the chambers
How the Heart Works

- Then, atria contract which squeezes blood out of the atria, through the valves, and into the ventricles.
- Ventricles then contract which closes the valves between the atria and ventricles - making the lub sound - and squeezes blood into large blood vessels.
- As the valves between the ventricles and blood vessels snap shut, they make the dup sound.
- *This all happens in less than a second*
How the Heart Works
The Force of the Ventricles

- When muscles cells in the ventricles **contract** they exert a force on the blood which pushes blood out of your heart and into **arteries**

- Contraction of the **left** ventricle exerts much **more force** than the contraction of the right ventricle
  - The right pumps blood just to the **lungs**
  - The left pumps blood throughout the **entire body**!
Regulation of Heartbeat

- The pacemaker, which is a group of heart cells, send out signals that make the heart muscle contract.
  - Located in the right atrium of the heart.
- The pacemaker is constantly getting messages about the body’s needs for oxygen and adjusts the heart rate to match the needs.
  - When exercising, your heart beats much faster than at rest because your muscles need more oxygen during exercise – this rapid heartbeat supplies oxygen throughout the body.
Regulation of Heartbeat

- Your pacemaker can become **damaged** due to a disease or an accident - this creates an **irregular** or slow heartbeat.
- In the 1950s doctors were able to create an **artificial**, battery operated pacemaker:
  - These are implanted **beneath** the skin and are **connected** to the heart by wires.
  - It sends tiny electrical **impulses** from the battery to make the heart contract.
This pacemaker has been implanted beneath a patient’s skin and connected with wires to the heart. The pacemaker will regulate the patient’s heartbeat.
Two Loops

Once **leaving** the heart, blood moves to blood **vessels** in your body.

There are three types of blood vessels – **arteries**, capillaries, and **veins**

- **Arteries** carry blood **away** from the heart – blood moves from arteries to capillaries.
- Capillaries are very tiny/narrow vessels and help to **exchange substances** between the blood and body cells – blood then flows into veins.
- **Veins** carry blood **back** to the heart.
Pattern of Blood Flow

- The flow of blood is similar to a figure 8, the heart being at the center where the two loops cross.
- In the first loop, blood travels from the heart to the lungs and then back to the heart. In the second loop, blood is pumped from the heart throughout the body and then goes back to the heart.
Pattern of Blood Flow

- The heart really has **two** pumps, one on the **right** side (pumping blood to the lungs) and one of the left (pumping blood to the rest of the **body**)

- Blood only travels in **one direction**

- The entire trip would take less than a **minute**
Blood circulates through the body in two loops, with the heart at the center. Loop one goes from the heart to the lungs and back. Loop two circulates blood throughout the rest of the body.
Loop One: To the Lungs and Back

- When blood flows into the right atrium it has little oxygen but a lot of carbon dioxide (dark red in color).
- Flows from right atrium and into the right ventricle which pump the oxygen-poor blood into the arteries that lead into the lungs.
- As blood flows through the lungs, oxygen moves from the lungs and into the blood.
  - At the same time, carbon dioxide moves in the opposite direction from the blood and into the lungs.
  - Now the blood is rich in oxygen and contains little carbon dioxide.
- This blood (bright red) flows to the left side of the heart and will be pumped through the second loop.
Loop Two: To the Body and Back

- Starts when the **left atrium** fills with oxygen-**rich** blood coming from the **lungs**
- This blood then moves into the **left ventricle** and then is pumped into the **aorta** (the largest artery in the body)
- After moving into branching arteries, the blood flows through tiny **capillaries** to different parts of the **body** (brain, liver, legs, etc.)
- These blood vessels are **close** to body cells allowing the **oxygen** to move into them
  - While this happens, the **carbon dioxide** passes into the blood and flows back to the **right atrium** of the heart through veins, completing the second loop
In loop two, oxygen-rich blood is pumped throughout the body. The oxygen moves out of the blood and into the body cells in this swimmer’s arms and legs.