College Guild
PO Box 696, Brunswick, Maine 04011

Health and Disease

Unit 1 of 5

The Cardiovascular System

Welcome to College Guild's course on Health and Disease! In this course you will learn about *how* some of the essential systems of the human body work, *what* interventions can potentially save a life, and *why* knowing about your body is essential in managing your health. This first unit will focus on the cardiovascular system and explain the significance of the heart and blood. The other units will focus on the respiratory system, nervous system, and immune system. Keep in mind: human health is very complex. There may be a lot of new concepts and words throughout this course, so don't get discouraged if you can't figure out a question. As always, learning at College Guild is about engaging, reflecting, and learning something new from the material — you won't be tested on "remembering everything."

DISCLAIMER: Under many prison regulations and restrictions, inmates are *not* allowed to provide medical care under the direction of organizations or educational resources such as College Guild. This curriculum therefore serves as a purely educational resource to those interested in learning (a) more about their health and (b) some of the interventions that medical professionals use, NOT as instructions to provide that medical care or directions to make treatment decisions.

Guidelines for all College Guild courses:

1. **Answer all the questions in bold print, using black or blue ink or dark pencil if possible.** After we receive and review your completed Unit, we will send you feedback from your reader along with your original work and the next Unit. You don't need to return the questions – it saves us both postage.
2. There is **no specific deadline** to complete any Unit, but we would get concerned if we hadn't heard back from you after two months.
3. Remember how often the mail service loses things. **If you don't hear back from us within 2 months, please write to ensure we received your unit** and sent out the next one.
4. Several questions ask you to draw/sketch something — please try these. It does not matter if you think you are a terrible artist; even stick figures are fine with us.

Glossary of Terms

1. **Cardiovascular system** (or **circulatory system**): The network (including the heart, blood, and blood vessels) that transports oxygen and nutrients to the body.
2. **Respiratory system**: The system that facilitates breathing (airways and lungs) and the exchange of oxygen and carbon dioxide.
3. **Blood vessels**: The tubular structures that transport blood. **Arteries** carry oxygenated blood away from the heart, while **veins** carry deoxygenated blood (containing carbon dioxide) to the lungs and heart.
4. **Alveoli**: Tiny sac-like structures in the lungs whether the exchange of oxygen and carbon dioxide occurs.
5. **BPM**: Meaning "heartbeats per minute."
6. **Shock**: A life-threatening condition when there is insufficient blood flow in the body.
7. **Heart attack** (known as **myocardial infarction**): When blood flow to the heart is reduced or stopped. Requires immediate medical attention.
8. **Coronary Heart Disease** (**CAD**): A disease where the arteries in and around the heart become blocked or

narrowed. This leads to restricted blood flow, and can cause dangerous conditions such as **myocardial infarction**.

9. **Plaque**: Build-up of fatty deposits on **artery** walls, reducing blood flow. The primary cause of **CAD**.
10. **Risk factors**: Factors or habits that increase the likelihood of developing a disease or other health problem.
11. **Processed foods**: Foods that have been changed from their natural state and often contain preservatives and sweeteners.
12. **Obesity**: The medical condition describing excess body fat. A major **risk factor** for heart disease.

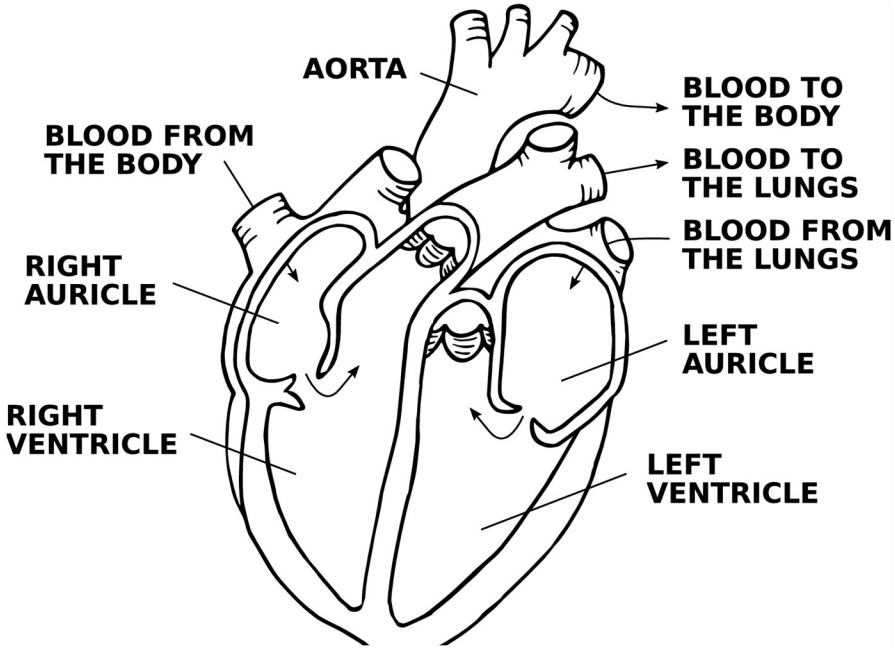
Part One: About The Cardiovascular System

The heart has long been known to be one of the most vital organs in your body, even before we understood its exact function. It's become a symbol ♡ in popular culture synonymous with love life itself. However, it is also one of our most vital organs: it should be no surprise that it is involved in a large proportion of medical emergencies. But to understand these medical emergencies, it's important to grasp the main components of the **cardiovascular** and **respiratory systems.** You may have heard of the heart as a "pump," but what exactly is it pumping?

1. **Phrases and terms like "heartbreak," "heartthrob," and "change of heart" are left from the time *before* we understood the brain's function. Why might it make sense that we previously believed the heart to be involved in our emotions?**

The **cardiovascular system** (think heart) and the **respiratory system** (think lungs) work together to help create the energy your body needs to live. The creation of this energy requires oxygen-filled blood to be delivered to cells all around our body. When you breathe in, you are taking in oxygen in the atmosphere into small sacs in your lungs called **alveoli**. Because **blood vessels** wrap **alveoli**, the oxygen is then transferred to the bloodstream where it moves to the heart to be pumped out to the rest of the body. After oxygen is delivered across the body, the deoxygenated blood returns to the lungs to restart the process.

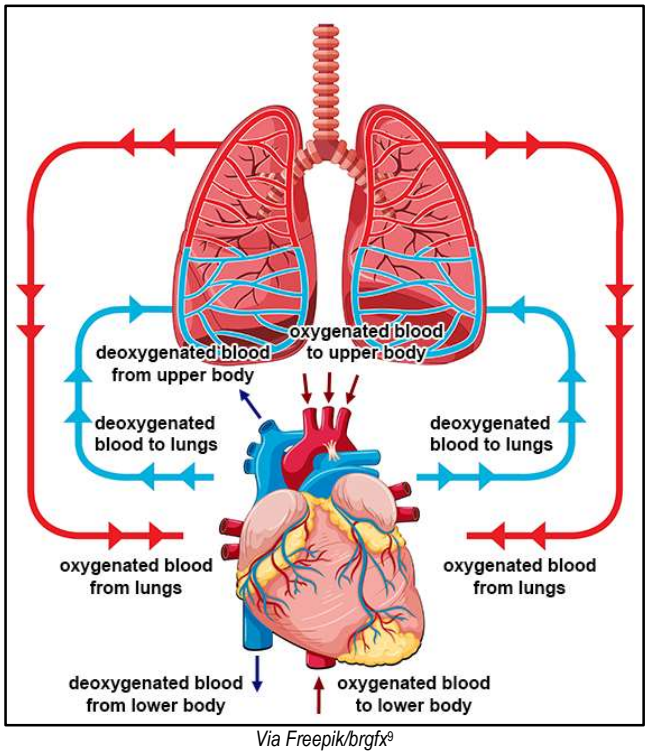
2. **Write a short story from the perspective of an oxygen molecule as it travels into our body from our lungs, to the heart, to somewhere in the body where it is needed. If you're feeling artistic, you can also draw a picture.**



Via OpenClipArt/Firkin[10]

This explains why we breathe *in* oxygen, but it doesn't explain why we breathe *out* carbon dioxide. When our bodies use oxygen to create energy, carbon dioxide is produced as a waste product. To remove this waste, carbon dioxide travels with the deoxygenated blood back to the lungs. In a process opposite to oxygenation, carbon dioxide moves from the **blood vessels** to the **alveoli** in the lungs, where it is then exhaled into the atmosphere. This constant cycle of *oxygen in* and *carbon dioxide out* happens throughout our bodies.

Therefore, the cardiovascular system plays a crucial role in maintaining our health, and is especially important to assess in emergency situations. One simple way to quickly assess this is by counting your heartbeat — or **beats per minute** (**BPM**). Each "lub-dub" sound counts as one heartbeat. You can find your pulse on your inner wrist (below where your thumb meets your wrist) or on your neck to either side of your windpipe (below the jawbone).



Via Freepik/brgfx[9]

TRY THIS: If you have access to a clock or wristwatch, calculate your resting **BPM**. To make it easier, health professionals will count a patient's heartbeats over 15 seconds and multiply that number by four. Since health information can be very private, don't feel the need to tell us your result.

3. **Have you ever measured your BPM before while exercising, or even out of curiosity?**

4. **With what you now know about the cardiovascular system, why might it make sense that our heart beats faster when we're exercising?**

One of the first things first responders do when approaching a patient is measure their **BPM**. A normal resting heart beat (when *not* engaged in physical exercise) is between 60 and 100 **BPM**. If a heart rate is below 60, it is **bradycardic**; if it is above 100, it is **tachycardic**. While it may be perfectly fine in some situations (such as sleeping or intense physical activity) to have **bradycardia** or **tachycardia**, it could also mean that the heart is struggling to pump enough oxygenated blood to your body — something that is concerning.

5. **Why do you think bradycardia might lead to fainting?**

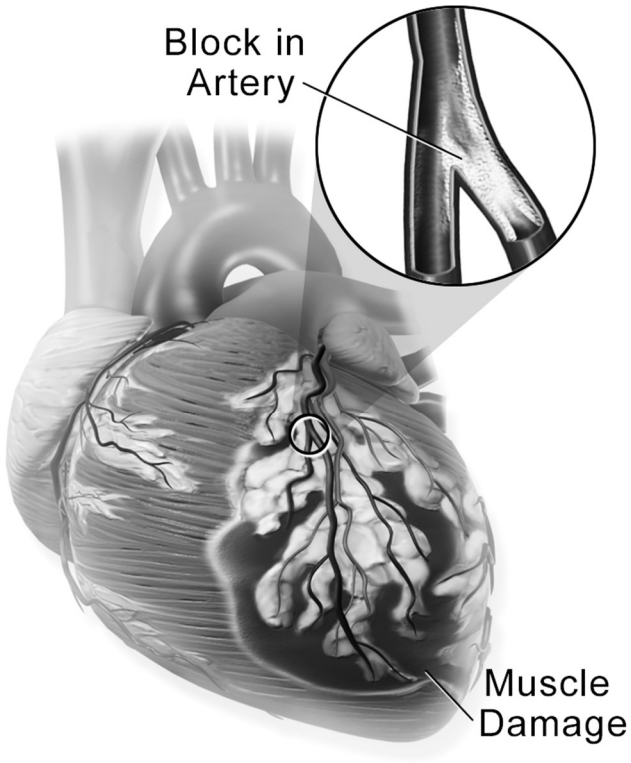
How To Recognize A Heart Attack

A **heart attack**, or **myocardial infarction**, happens when blood flow to the heart is blocked by fatty deposits called **plaque**. When **plaque** ruptures, it causes a blood clot to form, which can get stuck in the **arteries**. It feels like:

- A "crushing" or "squeezing" sensation in the chest.
- Pain "radiating" to other areas, such as the arms, neck, jaw, back, or stomach.
- Sensations of shortness of breath, nausea, lightheadedness, or dizziness.

A **heart attack** requires immediate medical attention, as it is life-threatening. Getting help should always be the first step. Heart attacks are immediately treated with Aspirin — a common drug often used for pain relief but also has the property of slowing down blood clotting.

6. **Imagine a distressed friend tells you it feels like their chest is being crushed by an invisible force. What might be happening inside their arteries — and what would you do?**



Heart Attack

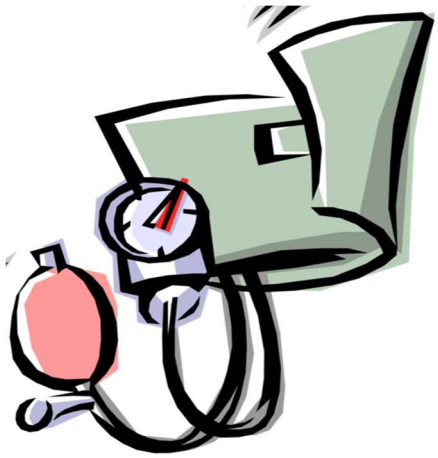
Via Wikimedia/Blausen Medical Communications, Inc.[6]

Another important measure of your **cardiovascular system's** immediate health is knowing your **blood pressure**. Most simply, **blood pressure** is the pressure of the blood pushing against the walls of the **blood vessels**. There are two important metrics of blood pressure: the *systolic pressure*, the pressure in your **arteries** when your heart pumps, and the *diastolic pressure*, the pressure in your **arteries** when your heart is resting between beats. They are typically written [systolic]/[diastolic] — for example, 110/70 (see picture below). Since a normal blood pressure is between 90/60 and 120/80, this would be considered a normal blood pressure.

7. **Hypothesize why diastolic blood pressure is always less than systolic. Think about the heart.**

8. **With what you know about the function of the cardiovascular system, why might *low* blood pressure (called hypotension) be a problem? If you want another challenge — why might *high* blood pressure (called hypertension) be a problem?**

(A) What "the numbers" of blood pressure mean



Designed by Wannapik Studio[5]

(B) Blood pressure cuff, often used during regular check-ups at the doctors' office

Along with pulse, blood pressure is among the first things first responders measure. It not only gives a sense of the overall health of the **cardiovascular system**, but can indicate dangerous situations. Of these, one of the most dangerous is **shock**, when the body isn't getting enough blood flow. **Shock** can be the result of many causes, such as a wound causing large amounts of blood loss (hypovolemic **shock**) to a severe allergic reaction (anaphylactic **shock**).

Because **shock** describes inadequate blood flow, one of the most important things done to treat it (after making sure help is on the way, of course) is to make sure blood is getting to the heart and brain — the most vital organs. To do this, you can elevate the patient's legs so that they are above the rest of the body, allowing blood flow to be redirected to these essential regions. First responders may also give the patient a blanket (to maintain body temperature — and provide comfort) and administer oxygen before rapid transport to a hospital.

9. **Why might elevating someone's legs help blood flow to the most essential regions?**

10. **In addition to medical support, one of the most important things you can do for someone experiencing shock is keep them comfortable. Explain how you would talk to a friend in shock to keep them calm.**

What an EMT Would Do: Taking Care of a Wound

As cuts and other open wounds can cause severe blood loss, they may also be considered a **cardiovascular system** emergency. Too much blood loss from a severe wound is called hypovolemic **shock**. Therefore, when caring for wounds, it is important to:

- Maintain a clean environment. Wash your hands!
- Apply firm pressure (using a clean ["sterile"] bandage or cloth) to stop bleeding.
- If possible, elevate the wound *above* the heart, reducing bleeding.
- Prevent infection. Infection can lead to greater medical issues (and is painful).
    - Clean the wound. Wash with cool water (don't use soap) and remove any dirt.
    - Bandages should be replaced at least once a day, or if it gets wet.
- *If the injury is caused by an object and is still deeply embedded in the wound, it shouldn't be moved. As the object may have pierced internal bodily structures, removing it may cause internal bleeding — a very threatening condition that likely requires hospitalization.*

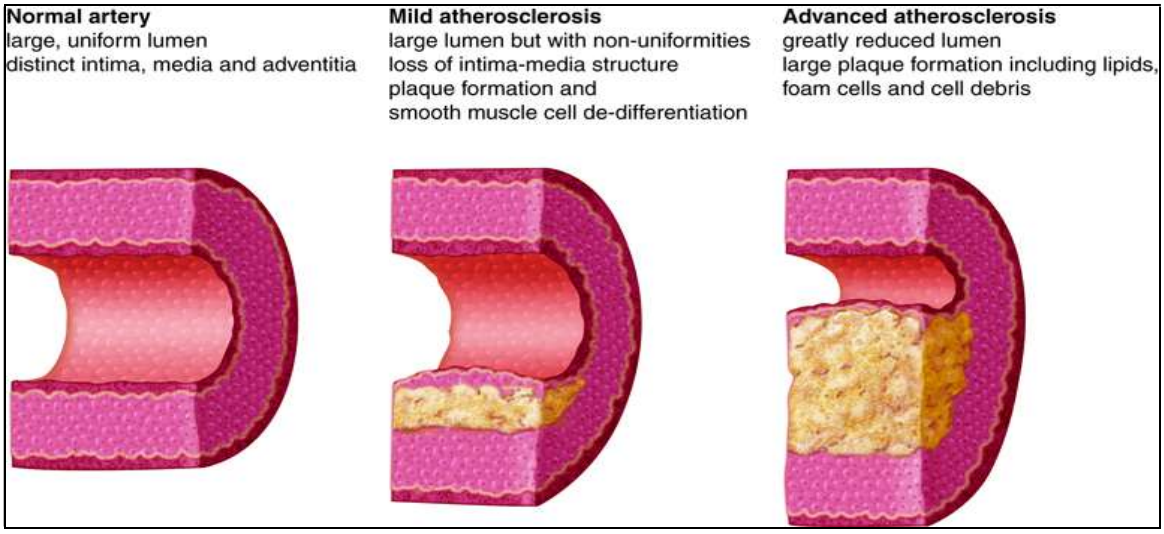
- The course of action here is to apply pressure to the wound, keeping the object in place before a medical professional can examine and treat it.

11. **It's possible to carefully place a sharp pencil through a balloon *without* it popping. However, if you take the pencil out, the balloon will deflate. How does this example resemble the *italicized* situation about an object impaled in a body?**

Part Two: Diseases of the Cardiovascular System

Diseases of the **cardiovascular system** are the *number one* cause of death in the world, by a large margin. In fact, about one third of all death can be attributed to diseases of the heart and vascular systems, which can cause life-threatening situations such as heart **attacks**. With what you now know, we will look at what these diseases are, what causes them, and how to improve your chances against them.

12. **Does it surprise you that cardiovascular disease is the leading cause of death in the world? Why or why not?**



Increasing degrees of plaque buildup in the arteries
Via Colorado Community College Online[8]

Among the most destructive diseases is **Coronary Heart Disease** (or **CAD**), claiming 40% of all deaths related to the **cardiovascular system**.[1] It occurs when your **arteries** in your heart become narrowed or blocked by waste buildup called **plaque**. This buildup makes it more difficult for your heart to pump oxygenated heart to your body (sound familiar?). This **plaque** consists of fat, cholesterol, and other cellular wastes that form from eating excess fatty, salty, and sugary foods. Interestingly, **CAD** only became the leading cause of death in 1950.[2] While there are countless reasons as to why there has been such an increase, we will examine the lifestyle choices that cause or increase risk of **CAD**. This means that *you* can make decisions to decrease your own chance of getting heart disease.

Diet

As mentioned, **plaque** buildup happens with the excess eating of salty, sugary, and fatty foods (especially saturated and trans fats, always listed on a product's "Nutrition Facts"). Therefore, avoiding foods high in these, such as in processed and factory-produced food such as fast food, bagged snacks, or cookies will reduce the **plaque** buildup that causes **CAD**. Because most processed foods were not as widespread a century ago (and most foods came fresh from local producers), it is recognized as a reason why the prevalence of **CAD** diagnoses have increased.

Processed foods at a grocery store
Via Flickr/WorldFish[7]

13. **Remember the story you wrote (question #2) about the journey of an oxygen molecule? How might that story be different for someone whose diet consists of ice cream, microwave meals, and instant ramen?**

14. **Give some examples of heavily processed foods that didn't exist 100 years ago that might contribute to plaque buildup in your coronary arteries.**

Physical Exercise

Ensuring you get enough physical exercise is another **lifestyle decision** that can significantly decrease your risk of **CAD** (among many other diseases). Experts recommend about 150 minutes (20-30 a day) of moderate physical activity a week.[3] This can look like a brisk walk or jog, playing basketball, or cycling. To go one step further, it is also recommended to include muscle-strengthening exercises (eg., bodyweight exercises, lifting weights) at least twice a week.

Physical exercise reduces the risk of **CAD** because it strengthens your heart (remember, your heart is a muscle), improves the circulation of your blood and lowers blood pressure, and reduces LDL (or "bad cholesterol"), an ingredient in **plaque**. This is of course in addition to the many other benefits of exercise, such as stress reduction, fitness, and improving your mental health. But, it's simple to understand that *not* exercising — especially when paired with an unhealthy diet — means you are much more likely to get **CAD**. Infact, **obesity** is one of the largest **risk factors** for **CAD**.[4]

15. **Do you have an exercise routine? If not, do you have the opportunity to start an exercise routine? Reflect about why you keep an exercise routine OR what is stopping you from starting one.**

There are other **risk factors** for **coronary heart disease**, such as having diabetes (discussed in Unit 3), smoking (discussed in Unit 2), having hypertension (high blood pressure), and a family history of **CAD**. It's important to not be discouraged by these facts, but know how to engage in healthy habits and ensure you are regularly seeking medical check-ups to catch any problems early when they can still be treated.

What *is* Health?

"Healthiness" can't simply be defined. Things like exercise and diet have a huge impact on your health, but they

are only a few of the many factors that determine your health. In addition, being "healthy" might look different for different people. It's important to recognize that it isn't a one-size-fits-all issue.

16. **Think of the *healthiest* person you know. What makes them earn this title?**

Your health is also influenced by factors outside of your control. For example, if you live in an area with substantial pollution, you are at a higher risk for cancer, respiratory issues, and heart disease. When you're constantly breathing in air pollutants (produced by vehicle emissions, coal power plants, or chemical production), you can cause inflammation in internal structures or damage your **blood vessels**. While we often think of diseases as purely biological issues, they are hardly that — where you live, how much money you make, and *even* the color of your skin can increase **risk factors** for worse health outcomes and your access to healthcare. We will continue to explore this complex phenomenon — understanding health as a social issue in addition to a biological one — throughout this course.

17. **Think of a way that poverty could cause worsened health outcomes. If you're struggling, refer to the various risk factors outlined above.**

This unit only scratches the surface of the **cardiovascular system** — there's a reason it takes 14 years to become a cardiologist in the U.S.! However, knowing just a little bit about how it works can be really important: for your health, but also in the case of being able to recognize a medical emergency, like a heart attack. Always remember: the best thing you can do in these situations is to first seek the appropriate help.

18. **What have you learned about the cardiovascular system that you didn't know before? Did anything surprise you?**

19. **Discuss something you learned that you can directly apply to your own life, whether it be a healthy habit or knowledge of how to spot a medical emergency.**

References

1. American Heart Association (2024). https://newsroom.heart.org/news/more-than-half-of-u-s-adults-dont-know-heart-disease-is-leading-cause-of-death-despite-100-year-reign#:~:text=Last%20year%2C%20the%20number%20of,rates%20seen%20in%20many%20years.
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4. Mayo Clinic (2024). https://www.mayoclinic.org/diseases-conditions/coronary-artery-disease/symptoms-causes/syc-20350613
5. *IMAGE*: Wannapik Studio https://www.wannapik.com/vectors/10168
6. *IMAGE*: Wikimedia/Blausen Medical Communications, Inc. https://en.m.wikipedia.org/wiki/File:Blausen_0463_HeartAttack.png

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