1.1.1 Homeostasis Defined

For an organism to exhibit normal cellular function it is required that the intracellular composition, with regard to water, pH, small molecules, ions, etc., be maintained within specific ranges. This maintenance is balanced by exchange through the membrane into and out of the cell. The human body has many different systems designed to maintain ranges, both within the cell, and within the organism as a whole, a theme that will be further developed this semester.

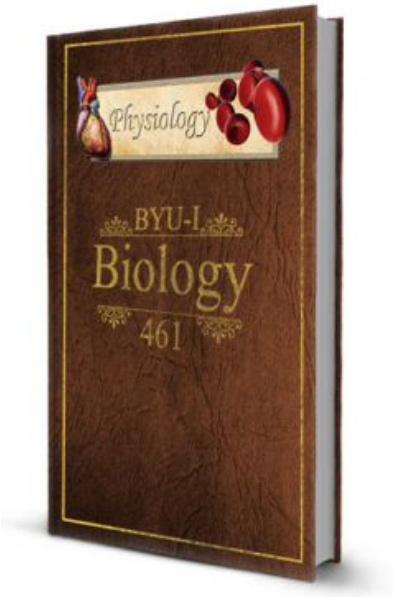
As an introduction, one of the defining features of warm-blooded animals, like humans, is the ability to maintain a core body temperature that is different from the environmental temperature. The average human core body temperature is around 98.6°F (37°C) give or take a degree in either direction depending on the time of day and the person. The body exerts a fair amount of energy ensuring that this temperature stays relatively constant; we call this temperature value (98.6°F) the **set point** for body temperature. Different set points for different systems are found throughout the body. For instance, the set point for glucose (blood sugar) is 85 mg/dl, and the set point for extracellular sodium is 142 mmol/L. The body uses a variety of organs and organ systems to help ensure that certain **variables** remain as close to their set point value as possible, or at least within a **normal range**. For example, without the assistance of clothing, the human body has a remarkable capacity for keeping the variable of body temperature between 98°F and 100°F, even when placed in environmental conditions that range from 68°F to 130°F. How does the body stay warm at 68°F and cool at 130°F? To stay warm, the body can increase metabolism, divert blood flow away

from the surface, or cause muscles to shiver. These mechanisms act to generate or conserve heat. Of course, we could also use our higher cognitive abilities and put some clothes on.

Conversely, to stay cool, the body releases water droplets on the surface of the skin, forming sweat, which acts to dissipate heat as the water evaporates. Some desert dwelling animals have adapted the ability to allow their core temperatures to rise without sweating to conserve water. This is how camels conserve water; they allow their body tempartue to increase from 93.2°F to 102.2°F (34°C to 39°C) during the heat of the day. Pregnant camels have been observed to go without water for 16 days without sweating or panting! One of the best desert adaptors is the Arabian Oryx with observed core temperature swings up to 107.6°F (42°C)!

Perhaps most interesting is that sweating (or not sweating), shivering, and blood flow diversions happen automatically; in other words, we do not consciously control them; they just seem to happen. This automatic property of the human body to regulate variables was observed and defined by Claude Bernard in 1854. Then, in 1926, Walter Cannon named this process **homeostasis**. Homeostasis, like many scientific words, is of Greek origin were homeo means "similar or same," and stasis means "standing still or remaining the same." Homeostasis then, by definition, is the ability of the body to maintain relatively stable internal conditions (internal environment) even though the outside world (external environment) is changing. The internal environment is defined as the fluid that surrounds the cells.

As will be explained, the human body undergoes a multitude of highly complex interactions to maintain homeostasis by ensuring that systems function to hold different variables within their normal ranges. These interactions are essential to the survival of the body. An inability to maintain homeostasis may lead to death or diseases such as: diabetes, dehydration, hyperthermia, and even allergic reactions.



Shaw, J. (n.d.). *BIO 461 Principles of Physiology*. EdTech Books. https://edtechbooks.org/bio_461_principles_o