Dr.Sarah Kamil
sarah.kamil@uomus.edu.iq

Homeostasis

The human body consists of trillions of cells all working together for the maintenance of the entire organism. While cells may perform very different functions, all the cells are quite similar in their metabolic requirements. Maintaining a constant internal environment with all that the cells need to survive (oxygen, glucose, mineral ions, waste removal, and so forth) is necessary for the well-being of individual cells and the well-being of the entire body. The varied processes by which the body regulates its internal environment are collectively referred to as homeostasis. Homeostasis was defined as a state of stable balance between physiological variables. Homeostatic regulation involves three parts or mechanisms

1) The receptor
2) The control center
3) The effector

A **sensor**, also referred to a receptor, is a component of a feedback system that monitors a physiological value. This value is reported to the control center. It receives information that something in the environment is changing.

The system is in a steady state, defined as a system in which a particular variable- temperature, in this case-is not changing but in which energy-in this case, heat-must be added continuously to maintain a constant condition. (Steady state differs from equilibrium, in which a particular variable is not changing but no input of energy is required to maintain the constancy). The steady-state temperature in our example is known as the set point of the thermoregulatory system (figure 1).

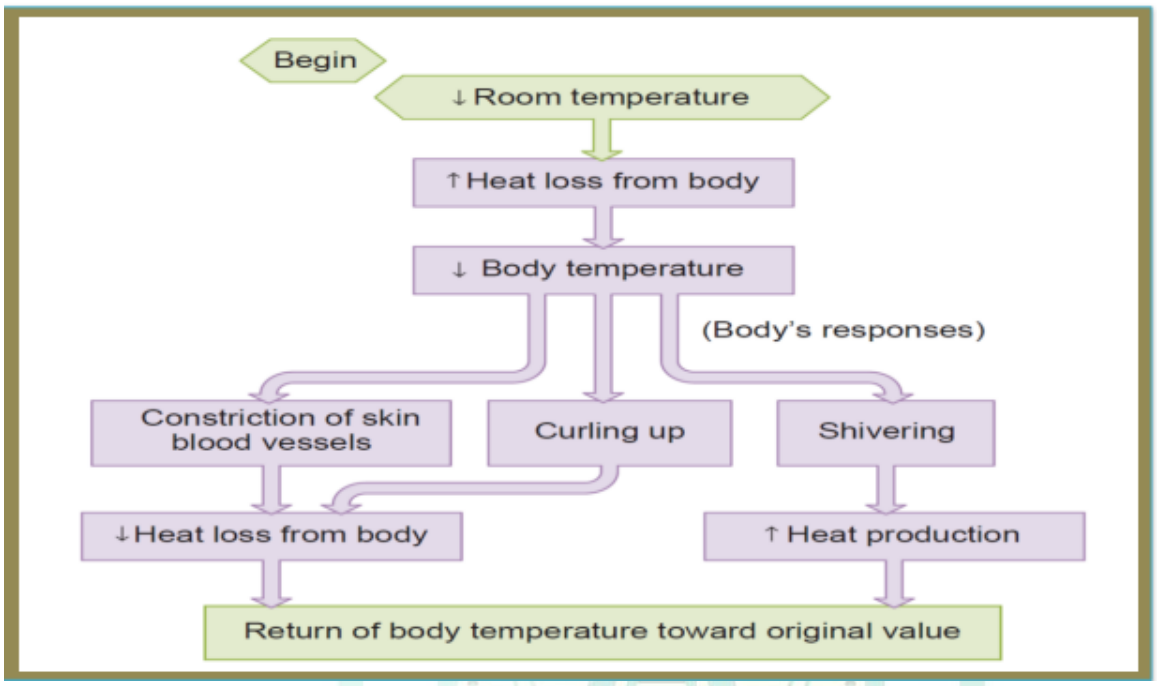

Figure 1: A homeostatic control system maintains body temperature when room temperature decreases

Our bodies control body temperature in a similar way. The brain is the control center, the receptor is our body's temperature sensors, and the effector is our blood vessels and sweat glands in our skin. When we feel heat, the temperature sensors in our skin send the message to our brain. Our brain then sends the message to the sweat glands to increase sweating and increase blood flow to our skin. When we feel cold, the opposite happens. Our brain sends a message to our sweat glands to decrease sweating, decrease blood flow, and begin shivering. This is an ongoing process that continually works to restore and maintain homeostasis. Because the internal and external environment of the body is constantly changing and adjustments must be made continuously to stay at or near the set point, homeostasis can be thought of as a **dynamic equilibrium**.

Positive and Negative Feedback

When a change of variable occurs, there are two main types of feedback to which the system reacts:

Negative feedback: a reaction in which the system responds in such a way as to reverse the direction of change. Since this tends to keep things constant, it allows the maintenance of homeostasis. For instance, when the concentration of carbon dioxide in the human body increases, the lungs are signaled to increase their activity and expel more carbon dioxide.

Positive feedback: a response is to amplify the change in the variable. This has a destabilizing effect, so does not result in homeostasis. Positive feedback is less common in naturally occurring systems than negative feedback, but it has its applications. For example, in nerves, a threshold electric potential triggers the generation of a much larger action potential.

Harmful Positive Feedback: although positive feedback is needed within homeostasis it also can be harmful at times. When you have a high fever it causes a metabolic change that can push the fever higher and higher.

Sustainable systems require combinations of both kinds of feedback. Generally with the recognition of divergence from the homeostatic condition, positive feedbacks are called into play, whereas once the homeostatic condition is approached, negative feedback is used for "Fine tuning" responses. This creates a situation of "Metastability," in which homeostatic conditions are maintained within fixed limits, but once these limits are exceeded, the system can shift wildly to a wholly new (and possibly less desirable) situation of homeostasis.

Pathways that alter homeostasis

A variety of homeostatic mechanisms maintain the internal environment within tolerable limits. Either homeostasis is maintained through a series of

control mechanisms, or the body suffers various illnesses or disease. When the cells in your body begin to malfunction, the homeostatic balance becomes disrupted. Eventually this leads to disease or cell malfunction. Disease and cellular malfunction can be caused in two basic ways: either, deficiency (cells not getting all they need) or toxicity (cells being poisoned by things they do not need). When homeostasis is interrupted in your cells, there are pathways to correct or worsen the problem. In addition to the internal control mechanisms, there are external influences based primarily on lifestyle choices and environmental exposures that influence our body's ability to maintain cellular health.

Nutrition: If your diet is lacking in a specific vitamin or mineral your cells will function poorly, possibly resulting in a disease condition. For example, lack of hemoglobin, a molecule that requires iron, will result in reduced oxygen-carrying capacity. In mild cases symptoms may be vague (e.g. fatigue), but if the anemia is severe the body will try to compensate by increasing cardiac output, leading to palpitations and sweatiness, and possibly to heart failure.

Toxins: Any substance that interferes with cellular function, causing cellular malfunction. This is done through a variety of ways; chemical, plant, insecticides, and or bites. A commonly seen example of this is drug overdoses. When a person takes too much of a drug their vital signs begin to waver; either increasing or decreasing, these vital signs can cause problems including coma, brain damage and even death.

Physical: Physical maintenance is essential for our cells and bodies. Adequate rest, sunlight, and exercise are examples of physical mechanisms for influencing homeostasis. Lack of sleep is related to a number of ailments such as irregular cardiac rhythms, fatigue, anxiety and headaches.

Genetic/Reproductive: Inheriting strengths and weaknesses can be part of our genetic makeup. Genes are sometimes turned off or on due to external

factors which we can have some control over, but at other times little can be done to correct or improve genetic diseases. Beginning at the cellular level a variety of diseases comes from mutated genes. For example, cancer can be genetically inherited or can be caused due to a mutation from an external source such as radiation or genes altered in a fetus when the mother uses drugs.