If you are too hot or too cold your body temperature is out of balance.
When we are too cold we shiver, it warms us up.

When we are too hot we sweat, it cools us down.
What is Homeostasis?

The maintenance of a constant environment in the body is called Homeostasis.
Exchange and communication are key concepts for understanding physiological homeostasis.
Examples of Homeostatically Regulated Variables

• Body Temperature
• Blood Composition (ions, sugars, proteins)
• Concentrations of $O_2$ and $CO_2$ in the blood
• Acid-Base balance (pH)
• Blood osmolarity
• Blood pressure, cardiac output, cardiac rate
• Respiratory rate and depth
• Secretions of endocrine glands
• Rate of chemical reactions *intracellularly*
Controlling body temperature

• All mammals maintain a constant body temperature.

• Human beings have a body temperature of about 37ºC.
  – E.g. If your body is in a hot environment your body temperature is 37ºC
  – If your body is in a cold environment your body temperature is still 37ºC
What mechanisms are there to cool the body down?

1. **Sweating**

   - When your body is hot, sweat glands are stimulated to release sweat.
   - The liquid sweat turns into a gas (it evaporates)
   - To do this, it needs heat.
   - It gets that heat from your skin.
   - As your skin loses heat, it cools down.
Homeostatic Regulation of Body Temperature through Negative Feedback

Hyperthermia → Heat receptors in the skin → Hypothalamus

Stress

Stress is reduced shutting down mechanism

Perspiration evaporates cooling the skin

Increased activity of sweat glands

Increased blood flow to the skin

Effectors

Effect

Control Center
Many homeostatic mechanisms use a nerve pathway in which to produce their effects. These pathways involve an afferent path which brings sensory messages into the brain and an efferent path which carries outgoing nerve messages to effectors.
Controlling Glucose levels

• Your cells also need an exact level of glucose in the blood.
• Excess glucose gets turned into glycogen in the liver.
• This is regulated by 2 hormones (chemicals) from the pancreas called:
  
  **Insulin**
  
  **Glucagon**
Negative Feedback

Insulin-secreting cells of pancreas stimulated to release insulin into the blood.

High blood glucose level detected by insulin-secreting cells of pancreas.

Liver takes up glucose and stores it as glycogen.

Most body cells take up more glucose.

Blood glucose level declines to a set point; stimulus for insulin release diminishes and body returns to homeostasis.

Stimulus: Rising blood glucose level.

Homeostasis: Normal blood glucose level (about 90 mg/100 ml).

Stimulus: Declining blood glucose level.

Blood glucose level rises to set point; stimulus for glucagon release diminishes and body returns to homeostasis.

Liver breaks down glycogen stores and releases glucose to the blood.

Glucagon-releasing cells of pancreas stimulated to release glucagon into the blood; target is the liver.
Homeostatic Regulation of Blood Sugar through Negative Feedback

Hyperglycemia → Pancreas-beta cells → Insulin is released into blood

Sensor and Control center

Stress

Blood glucose is reduced

Liver and Muscle cells take up glucose from the blood

Effectors

Stress is reduced, shutting down mechanism
Diabetes

• Some people do not produce enough insulin.
• When they eat food, the glucose levels in their blood cannot be reduced.
• This condition is known as DIABETES.
• Diabetics sometimes have to inject insulin into their blood. They have to be careful of their diet.
Controlling water levels

• The control of water levels is carried out by the KIDNEYS.
• It is closely linked to the excretion of urea.
• Urea is a waste product that is made when the LIVER breaks down proteins that are not needed by the body.
• Urea contains the element Nitrogen.
The kidneys

The kidneys “clean” the blood of waste products and control how much water is kept in the body. The waste products and water make up urine which is excreted via the ureter.

“Dirty” blood enters the kidney through the renal artery. Then, several things happen to clean the blood...
Positive Feedback Mechanisms

Homeostatic systems utilizing positive feedback exhibit two primary characteristics:

1. **Time limitation** – Processes in the body that must be completed within a constrained time frame are usually modified by positive feedback.

2. **Intensification of stress** – During a positive feedback process, the initial imbalance or stress is intensified rather than reduced as it is in negative feedback.

**Typical Positive Feedback Process**

- **Stress**
- **Sensor**
- **Control Center**
- **Effector**
- **Intensifies**
Harmful Effects of Positive Feedback

Positive feedback can be harmful. Two specific examples of these harmful outcomes would be:

1. Fever can cause a positive feedback within homeostasis that pushes the body temperature continually higher. If the temperature reaches 45 degrees centigrade (113 degrees Fahrenheit) cellular proteins denature bringing metabolism to a stop and death.

2. Chronic hypertension can favor the process of atherosclerosis which causes the openings of blood vessels to narrow. This, in turn, will intensify the hypertension bring on more damage to the walls of blood vessels.