Supplement to “Do the ‘Brain Dead’ Merely Appear to be Alive?” by Michael Nair-Collins and Franklin G. Miller.

Supplementary Table 1. Selected mechanisms involved in maintaining homeostasis of the extracellular fluid

- Acid-base regulation via the kidneys and lungs, along with the bicarbonate buffer system in the extracellular fluid, the hemoglobin buffer in red blood cells, and multiple other chemical acid-base buffering mechanisms
- Regulation of extracellular fluid osmolarity and sodium concentration via hypothalamic secretion of vasopressin through the posterior pituitary, acting on the kidneys, which allows for regulation of water excretion independent of solute excretion
- Potassium ion concentration regulated by maintenance of the internal distribution of potassium in the intra- and extracellular fluid, via insulin (secreted by the pancreas) and aldosterone (secreted by the adrenal glands); and excretion of potassium by the kidneys, largely regulated by aldosterone from the adrenal glands
- Calcium and phosphate concentration, largely regulated by parathyroid hormone secreted by the parathyroid glands, which acts on bone, the intestines, and kidneys
- Magnesium concentration maintained by interactions among the kidneys, intestines, and bones
- Digestion of carbohydrates, proteins, and fats into glucose, amino acids, and fatty acids by multiple enzymes and other factors secreted by the stomach, pancreas, gallbladder, liver, and small intestine
- Absorption of nutrients, water, and electrolytes through the small and large intestine and into blood circulation
- Tightly regulated propulsion and mixing of gastrointestinal contents throughout the entire tract, allowing digestion and absorption of nutrients, electrolytes, and water, and excretion of waste, controlled by the enteric nervous system
- Glucose availability regulated by interactions between the pancreas, liver, muscle cells, and fat tissue involving secretion or uptake of insulin and glucagon, synthesis or degradation of glycogen, and gluconeogenesis (synthesis of glucose) from lactate and amino acids
- Regulation of energy stores and metabolism through production of ATP from glucose (and other chemical products), the final step of which occurs in the mitochondria of all cells; ATP is required for nearly every cellular function including active transport across membranes, muscle contraction, synthesis of molecules, secretion of enzymes and other substances, cell division and growth, etc.
- Regulation of lipid metabolism for adequate supply of phospholipids and cholesterol needed for structural purposes such as cell membranes and for synthesis of many hormones and bile, and triglycerides used for energy; lipid metabolism is largely regulated by the liver and fat tissue
- Formation of most plasma proteins along with amino acid synthesis or interconversion in the liver
- Formation of urea in the liver to remove toxic amounts of ammonia from the body

- Maintenance of the blood-air barrier and thus a gas partial pressure difference between alveolar air and pulmonary capillary blood by Type I pneumocytes, allowing passive diffusion of oxygen and carbon dioxide, along with production of surfactant by Type II pneumocytes, preventing alveolar collapse
- Synthesis of hemoglobin-containing red blood cells in the bone marrow, stimulated by erythropoietin from the kidneys, balanced by degradation and recycling of these cells in the spleen and liver at a roughly constant rate of synthesis and degradation
- Platelets formed for blood coagulation from megakaryocytes synthesized in the bone marrow
- Maintenance of blood pressure to allow adequate perfusion of all organs and tissues, along with regulation of blood and extracellular fluid volume, via the renin-angiotensin-aldosterone system involving the kidneys, liver, lungs, adrenal glands, and vasculature, which can be triggered by secretion of atrial natriuretic peptide or brain natriuretic peptide from the atria and ventricles of the heart, respectively
- Protection from invading pathogens via innate immunity including resistance by the skin to microbe invasion and phagocytosis of pathogens by the tissue macrophage system; these cells are largely formed in the bone marrow and lymph nodes, with macrophages especially present in subcutaneous tissues, lymph nodes, alveoli, liver sinusoids, spleen, and bone marrow
- Protection from invading pathogens via acquired immunity including: B-lymphocyte mediated production of antibodies; T-lymphocyte immunity in which T-cells actively destroy specific targeted pathogens; and activation of the complement system by antigen-antibody reactions. Lymphocytes develop from hematopoietic stem cells in the bone marrow and once formed are located mostly in the lymph nodes.

Summarized from: Hall JE. Guyton and Hall textbook of medical physiology, 13th ed. Philadelphia: Elsevier; 2016.