1. A friend of yours returns from the doctor and says that they were diagnosed with Myasthenia Gravis. She isn’t sure what the condition is and asks you, a brilliant physiologist, to explain it to her.

Myasthenia gravis is an **autoimmune disease where antibodies attack the ACh receptors on the neuromuscular junctions.** It results in progressive weakening of the skeletal muscles. Treatment usually involves **anticholinesterases** such as neostigmine and physostigmine. These **decrease the activity of acteylcholinesterase** and help to restore muscle strength because **ACh is able to stimulate the muscle longer to achieve a contraction.**

2. Explain what the acronym SSRIs stand for and describe the mechanism of action of SSRIs such as Prozac, in the treatment of depression.

SSRIs stands for **selective serotonin reuptake inhibitors.** They are a class of medications that are used to treat depression, which is **characterized by a deficiency of serotonin.** These antepressents work by **selectively blocking the reuptake of serotonin into the presynaptic axon terminals.** The neurotransmitter serotonin is allowed to stay longer in the synapse (since its “uptake” is inhibited), thereby **activating postsynaptic neurons that maintain a more positive mood.** Common SSRIs include Prozac, Paxil, and Zoloft.

3. A patient has hypothyroidism and is confused about its classification. You are asked by the patient to explain the classification of hypothyroidism.

Thyroid gland disorders affect all major body systems and are among the most common endocrine disorders. **Hyposecretion of thyroid hormone (hypothyroidism) is classified as primary, secondary or tertiary** dependent upon the organ that is malfunctioning.

**Primary hypothyroidism** (most common type): the **thyroid gland** is malfunctioning and results in decreased production of thyroid hormones.

**Secondary hypothyroidism:** the **pituitary gland is malfunctioning.** The pituitary gland does not create enough **thyroid stimulating hormone (TSH or Thyrotropin)** to induce the thyroid gland to create a sufficient quantity of thyroid hormones.

**Tertiary Hypothyroidism:** the **Hypothalamus is malfunctioning.** This results in decreased production and/or reduced delivery of **thyroid-releasing hormone (TRH)** from the hypothalamus to the pituitary gland.

4. List four adrenergic receptors found in the human body. List two cholinergic receptors found in the human body

**Adrenergic receptors:** alpha 1, alpha 2, beta 1, beta 2
**Cholinergic receptors:** nicotinic and muscarinic
5. A friend of yours just found out she has diabetes mellitus. Being the caring, inquisitive, well-educated person that you are, you ask what type of diabetes mellitus she has. She said that it was either type I or type II but was not sure and didn’t realize the difference between them.

Explain the difference between type I and type II diabetes mellitus and their treatment.

Diabetes mellitus type I and type II are a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin sensitivity, or both. Both Type I and II will have an elevation of glucose in the blood (hyperglycemia) and an increase of glucose loss in the urine (glucosuria).

**Type 1 Diabetes or Insulin-Dependent Diabetes Mellitus (IDDM):** Results from a deficiency of insulin, usually due to the person’s own immune system (autoimmune disorder) destroying the pancreatic beta cells that produce insulin.

**Treatment:** As a result the pancreas produces little or no insulin and insulin injections are required to prevent death.

**Type 2 Diabetes or Non-insulin-dependent diabetes mellitus (NIDDM):** The cause is a lack of responsiveness or sensitivity of the insulin receptors to insulin, which may be at normal or elevated levels. The symptoms are usually mild and sporadic and the condition may go unnoticed for years before diagnosis. Type 2 may progress to destruction of the insulin-producing cells, but is still considered Type 2, even though insulin administration may be required.

**Treatment:** Usually controlled and corrected by exercise, proper diet, and weight loss. Metformin (Glucophage) is an oral anti-diabetic drug that improves hyperglycemia by (1) suppression of hepatic glucose production (gluconeogenesis), (2) increases insulin sensitivity, an (3) enhances peripheral glucose uptake by increasing the quantity of GLUT4 receptors incorporated into the plasma membrane.

6. A friend of yours just found out she has diabetes insipidus. She is not sure what this diagnosis means or how it is caused. Explain the details of diabetes insipidus and how it is treated.

To understand diabetes insipidus you must first understand the effects of antidiuretic hormone. Antidiuretic hormone (ADH) is produced by the hypothalamus and released from the posterior pituitary gland in response to decreased blood volume (pressure) or increased blood osmolarity (solute concentration). ADH stimulates the kidneys to retain water so that less water is excreted in the urine and more is retained in the blood thereby raising blood pressure. Diabetes insipidus is a disorder due to defects in antidiuretic hormone (ADH) receptors or an inability to secrete ADH. Neurogenic diabetes insipidus results from hyposecretion of ADH, usually caused by a brain tumor, head trauma, or brain surgery that damages the posterior pituitary or the hypothalamus. In nephrogenic diabetes insipidus, the kidneys do not respond to ADH. The ADH receptors may be nonfunctional, or the kidneys may be damaged. A common symptom of both forms is excretion of large volumes of urine, with resulting dehydration and thirst. Bedwetting is common in afflicted children. Because so much water is lost in the urine, a person may die of dehydration if deprived of water for only a day or so.

**Treatment** of neurogenic diabetes insipidus involves hormone replacement. Either subcutaneous injection or nasal spray application of ADH is effective. Treatment of
nephrogenic diabetes insipidus is more complex and depends on the nature of the kidney dysfunction.

7. Explain what the acronym “NSAIDs” stands for. Explain what INSAIDs are and their mechanism of action. Be sure to give examples of commonly used NSAIDs and what a person need to be cautious of when taking them.

Nonsteroidal anti-inflammatory drugs (NSAIDs) are a class of drugs that reduce inflammation (pain, fever, and swelling) by interfering with the production of prostaglandins. **Mechanism of action:** Depends on the NSAID. NSAIDs can inhibit either or both Cyclooxygenase-1 (COX-1) and Cyclooxygenase-2 (COX-2) enzymes and thus the production of prostaglandins.

Examples: Aspirin and ibuprofen (Advil, Motrin) are not as specific and inhibit both COX-1 and COX-2 enzymes. **Aspirin inhibit prostaglandin production in blood platelets and inhibits blood clotting thus reducing the risk of heart attacks and strokes.** **Caution:** Some of the prostaglandins made by COX-1 protect the inner lining of the stomach. When common NSAIDs such as aspirin block COX-1, inflammation is reduced, but the protection of the lining of the stomach also is lost. This can cause stomach upset as well as ulceration and bleeding from the stomach and intestines.

Examples: Celebrex and Vioxx selectively block the COX-2 enzyme and **not the COX-1 enzyme and thus inhibit the production of prostaglandins that often cause the pain and swelling of inflammation.** Usually taken for conditions such as arthritis (osteoarthritis and rheumatoid), menstrual pain, and acute pain. Since the COX-2 enzyme does not play a role in protecting the stomach or intestine, **COX-2 specific NSAIDs do not have the same risk of injuring the stomach or intestines.**

8. You return home to find your little sister crying about her dead hamster Sparky, who is very stiff. In an effort to cheer your sister up you decide to teach her about why Sparky is so stiff. What are the details of this condition that causes the stiffness.

The condition is known as rigor mortis and usually occurs several hours after death. **It is caused by a lack of ATP in muscles to allow cross-bridges to release.** Upon death, muscle cells are unable to prevent calcium entry from the sarcoplasmic reticulum. Calcium binds to troponin and causes the troponin tropomyosin complex to move out of the way and allow myosin to bind to actin. Since there is **no ATP made postmortem, the myosin cannot unbind** and the body remains in a state of muscular rigidity for a day or two.

9. Your grandmother wants to get rid of her facial wrinkles by using BOTOX. She doesn’t understand what it is and why it works. Give an explanation for the details about BOTOX.

BOTOX is a trade name that stands for botulinum toxin, which is **produced by the bacterium Clostridium botulinum.** The toxin inhibits acetylcholine release by motor neurons at the neuromuscular junctions resulting in flaccid muscle paralysis. Paralyzed muscles do not contract to wrinkle the skin and thus help to eliminate wrinkles – as well as certain facial expressions.