Before defining intestinal plasticity, it is important to define what a sit-and-wait predator is to understand why such an evolutionary feature would be beneficial to them. A sit-and-wait predator can be defined as a consumer whose gut is able to lie dormant for up to months at a time to decrease energy use in the process of consumption and digestion (Secor 2008). Their intestines, which are unused for several weeks at a time, have the ability to quickly "awaken" to digest a meal and return to their unused state (Secor 2008). For a predator who goes up to months without consuming another organism, which is their main source of energy, intestinal plasticity is very crucial. Intestinal plasticity refers to the ability of the digestive intestines to grow and retract in size in occurrence with consumption and fasting (Le Gall et al. 2019). For sit-and-wait predators, the possession of intestinal plasticity is highly beneficial as it allows their stomach to grow drastically after weeks or months of fasting, and return to a dormant state without harming the animal. The gastrointestinal tract referenced is responsible for not only the absorption and digestion of nutrients but also the secretion of hormones that are vital to many functions of life (Le Gall et al. 2019).

An example of such hormones that are essential to life include the secretion of calcitonin and parathyroid hormone, which both operate with the goal of regulating phosphorus and calcium levels within the body. Parathyroid hormone or PTH regulates calcium and phosphorus in the body within the gastrointestinal tract by increasing the resorption of calcium directly. The absorption of calcium within the intestine is indirectly influenced by the increase of calcitriol (Raisz 1981). Calcitonin works in a more inhibiting nature as it decreases the movement of calcium from blood to bone from the intestine, directly preventing disorders such as hypercalcemia (Raisz 1981). Unique cellular processes such as the ones described have been studied by scientists for decades, and new and emerging technology has given them the ability to understand such processes beyond the macroscopic level. Two examples of methods by which scientists can study and begin to truly understand these processes include both electron microscopy and energy-dispersive x-ray analysis.

Electron microscopy (EM) and energy-dispersive x-ray (EDX) analysis are coupled techniques, where EM is used to observe biological samples on the scale of the nanometer, and EDX analysis allows for the investigation of the sample. Electron microscopy operates by shooting a beam of electrons on a sample, thus revealing microscopic details (Scimeca et al.). As a result of the electron beam interacting with the biological sample, the sample emits x-rays that are unique to that sample, which can in turn be analyzed by EDX to determine the specific atoms and the amounts of said atoms present in the sample (Scimeca et al.). Such techniques allow scientists to understand the biological world on a scale never before understood. From the macroscopic scale in animals such as the Burmese python, to microscopic processes such as hormone secretion, all processes no matter the size are essential to life and as scientists grow in their understanding of these functions on extremely small scales, the world of biology will only continue to grow.

In all life on Earth, there are an endless number of regulatory, sort of checks and balances, present within living organisms to ensure adaptation and evolution to aid in their survival. Elements needed for survival are very common among different species, an example of this being calcium. To explore this idea, one can observe the regulation of calcium in the Burmese python, and the different cells located within them that assist in the regulation of this life-essential element.

Based on the diet of the Burmese python, as in most other animals (including humans), there are regulatory processes that occur within the body to regulate calcium levels when they have either become too low or too high. Snakes regulate their blood calcium levels through the use of calcitonin and parathyroid hormone (PTH). Snakes acquire the calcium that they need for survival by ingesting whole mammals and birds, extracting calcium from their bones. When blood calcium levels become too low, PTH is secreted from the parathyroid gland. It allows the release of calcium from the bone into the bloodstream, as well as allowing the action of calcitriol. Calcitriol is produced in the liver and kidneys, and allows calcium to be absorbed from the intestines (Lignot et al., 2025). Calcitonin has the opposite function and is released when blood calcium levels are too high (Lignot et al., 2025). Calcitonin inhibits the function of osteoclasts, which is to degrade mature bone cells to release calcium into the bloodstream. The rate at which PTH and calcitonin are secreted and used by the body can differ based on the diet of the python in regard to how rich or deficient in calcium it is.

During fasting or a low calcium meal, it would be expected for the blood calcium level to drop, which would trigger the release of PTH. When fed a normal diet or a calcium rich diet, blood-calcium levels would be expected to rise, which could also trigger the release of PTH to ensure that balance is maintained. To ensure that the pythons can properly adjust to the ever-changing levels of calcium present in their blood, other checkpoints and structures exist to allow the animal to adapt to this flux of nutrition.

Calcitonin and PTH are not responsible alone for calcium regulation in the Burmese python. These snakes possess specialized cells that are located in their intestine that contain special folds called crypts. Within the crypts of these specialized cells are particles that are composed of multiple layers of calcium and phosphorus with an iron center. Figure three of this article illustrates the use of transmission electron microscopy (TEM) to analyze the composition of crypt particles. The peaks on the graph of part A of figure three are indicative of the presence of calcium and phosphorus, while part E illustrates the increase of iron towards the center of the particle (Lignot et al., 2025). In the same way in which the presence of calcitonin and PTH can be observed at different levels in the snake based on diet, the presence of particles within the crypts of these specialized cells are indicative of the presence or lack of calcium in the diet. The role of these specialized cells is to absorb excess calcium that is present within the bloodstream, therefore the presence of particles within the crypts is directly proportional to the amount of calcium present in the snake's diet. Figure one within the article displays what different intestinal crypts look like as a result of different diets. Part A of this figure illustrates the gut of a fasting snake which has a crypt lacking particles, and part E posses a particle, indicating that the snake has been fed, possibly even a calcium rich diet (Lignot et al., 2025). Because these crypts posses the main function of extracting excess calcium from the diet of the python, the lack of calcium in a meal or the lack of a meal entirely will lead to empty crypts with no particles.

Based on the evidence presented about the specialized intestinal cells found in the Burmese python that contain crypts filled with calcium-rich particles, the conclusion can be made that these are not a new cell type. There are two main reasons for which this can be determined. The first being that the sample size of this experiment is too small for the information within this study to be conclusive. If nothing else, it would be beneficial in supporting this evidence if this experiment was repeated more than once. The second reason for which this cell type should not be considered new is its presence, or very similar presence in a number of other animals. The article lists a vast number of animals including different species of snakes and lizards that posses particles that are very similar in nature, being composed of calcium, phosphorus, and iron.

The research conducted directly correlates with the class material in relation to the endomembrane system. The specialized cells discussed are located in the intestine and are pseudostratified columnar in nature, meaning that they possess the function of secretion. This function, as well as recycling of the membrane is carried out by organelles in the endomembrane system including vesicles, endosomes, and lysosomes. The observation of these functions was also carried out by many of the microscopy techniques discussed in class, including light microscopy and transmission electron microscopy.

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