**Biology Animals Unit Storyline**

The Animals Unit content directly builds off the Matter and Energy Unit. A critical consideration of this class is that all matter and energy can be traced from the start of a biological reaction to the end.

In the case of combustion, the carbon, oxygen, and hydrogen atoms in both ethanol and wood were rearranged with the oxygen atoms in the air to form CO2 and H2O. The energy in the high energy bonds of ethanol and/or wood was transformed to create the heat, light, and motion that we can observe in a flame.

A similar process occurs in the cells of all living organisms. All cells must acquire a source of chemical energy (usually the high-energy bonds of glucose) and rearrange the atoms in these molecules along with oxygen in the air to form CO2 and H2O. However, unlike combustion, the chemical energy in the high energy bonds of glucose is moved to a new molecule called ATP. ATP works as a sort of molecular battery for the cell - it can be recharged repeatedly using the high energy bonds of consumed glucose molecules. This is cellular respiration. Eventually the energy in ATP is transformed into heat and motion and leaves the cell. At this time, ATP has to be 'recharged' by another round of cell respiration in the mitochondria inside each cell.

This leads to the question of where the atoms in the cells come from. Every cell in every living organism must acquire atoms from outside the cell for growth and repair. This occurs through biosynthesis - each cell must take in molecules from food (usually amino acids and fatty acids) and assemble these molecules to create the macromolecules the cell is made from. The membranes of cells are composed of fats; the functional structures inside of cells are primarily comprised of proteins. During biosynthesis, cells absorb amino acids and assemble them into protein-based structures; they also absorb fatty acids and assemble them into the membranes of the cells and organelles.

This was evident in the investigation where worms ate potatoes. The worms gained mass, but not as much mass as they consumed in potatoes. The mass their bodies gained was primarily from the fat and protein they consumed in the potatoes. The fat and protein molecules were broken down into fatty acids and amino acids by enzymes in their stomachs. These molecules were then sent to the cells through the blood to be reassembled into the fat and protein structures inside the cell.

The mass of potatoes that was consumed by the worms but not added to their own mass primarily consisted of carbohydrates that were rearranged into CO2 and H2O through cell respiration. The carbohydrates in the potato were broken down into glucose, absorbed by the cells, and rearranged with atoms of oxygen to form CO2 and H2O in the mitochondria. During this process, the energy in the glucose was moved to ATP, and the CO2 and H2O was released into the air.

So in all these examples, we need to know the difference between matter and energy. We need to know the difference between atoms, molecules, and macromolecules. We need to be able to trace how atoms are rearranged to form new molecules. And we need to be able to trace how energy is transformed from one type (e.g., chemical) to another (e.g., heat or motion).