Paper or Plastic? Sustainable Products and Technologies for the 21st Century

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Global sustainability is one of the defining and most complex challenges of this century. In this seminar, we will discuss what 'sustainability' really means and will seek to understand how the industrial processes and materials that drive and support our society have been developed. Particular emphasis will be placed on understanding the many complex and interwoven economic, societal, scientific and environmental factors that ultimately dictate how sustainable these processes and product may or may not be. We will often find that the 'sustainability' picture is not nearly as simple or clear cut as one might normally assume.

As one example of how complex a full sustainability analysis can be, we will consider choosing between paper and plastic bags when one checks out at the grocery store. If we look at the physical/chemical composition of the paper bag, we see that it is comprised of processed wood fibers and is readily biodegradable. The plastic bag on the other hand is produced from polymerized chemicals obtained from oil refining. The plastic bag is not compostable/biodegradable leading to the common assumption that the paper bag is the more sustainable choice – if both bags wind up in the environment, only the plastic bag will persist for many years. This analysis is incomplete, however, as there are many factors that determine the sustainability of a given product or material. Although the plastic bag does not biodegrade, it does have redeeming qualities that make the sustainability decision less clear cut. For example, we could contemplate how much energy it takes to make a paper bag versus a plastic bag, and then consider the amount of CO_2 that is produced and released to the atmosphere upon production of each. We can consider how many times each bag is likely to be reused before being discarded. We can consider the weight of the two products and correlate that to how much energy it takes to ship the bags to the store. We also can consider how easily the two types of materials are recycled and how available and costly the raw materials that go into paper versus plastic production may be. When we consider all of these factors (and many more) it's no longer immediately clear whether paper or plastic is the more sustainable choice.

The above 'paper or plastic' analysis represents just one of many that we will consider during this seminar. Two other interesting technologies to consider are conventional cars (internal combustion engine) versus electric vehicles, and wind farms versus natural gas power plants. While major portions of this seminar will deal directly with areas relevant to the physical sciences (i.e., physics, chemistry, biology and materials science), significant time will also be spent understanding how financial and societal factors help to determine why certain processes, materials and technologies are more important and/or sustainable than others. I will plan to use demonstrations where appropriate to illustrate some of the scientific principles we examine and we will relate our discussions to K-12 Delaware Next Generation Science Standards including areas of emphasis such as *structure and properties of matter*, *trees and wood*, *ecosystems*, *land and water*, *engineering design*, *chemical reactions*, and *energy*, among others. I can imagine teachers from many fields but especially those in social studies and the sciences developing curriculum units that link the themes we will discuss in this seminar to their work in the classroom.