**Atoms, Molecules, Bonding and Beyond**

**Subject area:** Science **Intended course:** Chemistry

# STUDENT INSTRUCTIONS

1. **Task context**:

Why do we eat blueberries? For one thing, they taste good. But blueberries also have the property of having antioxidants, and antioxidants are known to kill free radicals in the body. Such an important reaction is triggered by antioxidants in the body and results in bond breaking.

Some common examples of antioxidants are Vitamin E: d-­‐alpha tocopherol, Vitamin C: Ascorbic acid, and Beta-­‐carotene: a precursor to vitamin A (retinol). In modern medicine, there is a major emphasis on developing new drugs that attack diseased cells in the body, and the mechanism of the attack involves essentially bond breaking or bond making. Therefore, in this context, it is important to understand the fundamentals of chemical bonds.

Body tissues suffer from oxidative stress due to the process of oxidation as cells age. When some key molecules get oxidized within the body, they lose electrons to other charged molecules of oxygen in the blood stream. Such electron-­‐rich oxygen molecules are called free radicals, and they have the potential to cause damage to cellular DNA. Over time, the damage can become irreversible and lead to disease.

The more free radicals build up in one's body, the more oxidative stress one encounters.

In Chemistry, we have studied the formation and types of chemical bonds, and their relation to molecular shapes, resonance, and dipole moment. Although this simplified picture offers a fundamental understanding of the formation of chemical bonds, it gets more complicated when more than two atoms are involved in a chemical compound (polyatomic systems). However complicated the idea is, this concept of individual bonds makes it much easier to deal with complex molecules such as DNA. Such a model offers unique opportunities to understand the mechanism of how medicines interact with cells to prevent the occurrence of diseases.

Using the concepts of chemical bonding, you will need to investigate the mechanism of how antioxidants and free radicals interact to eventually eradicate the free radicals that act as the source for different illnesses. Your research must be based on different source materials, including web sites on this topic such as the ones given below.

# The task:

After researching reliable sources on the topic of antioxidants and free radicals, write a 2-­‐page paper in which you 1) explain how the intake of antioxidants prevents formation of free radicals, 2) give a specific example of an illness that is cured by an antioxidant, and 3) explain how this reaction may be connected to bond breaking or formation. Support your position with evidence from your research. Be sure to include the oxidized chemical species and formation of new bonds in the example you select.

Discuss also the change in geometric shape before and after the oxidation in light of VSPER model.

Your paper should:

* + Provide a concluding statement or section that follows from and supports the information or explanation provided.
  + Discuss limitations of the supporting studies.
  + Use discipline-­‐specific vocabulary.
  + Cite your sources correctly in the text of your paper and create a Works Cited page using MLA format or another style that your instructor selects.

# Materials/resources:

* + Chemistry textbooks and library access for web-­‐based research
  + Relevant web sites, including: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249911/> <http://www.healthchecksystems.com/antioxid.htm>
  + Ball and stick model (to realize simple molecular structures)
  + Periodic table
  + Notebook