**Atoms, Molecules, Bonding, and Beyond**

**Subject area:** Science, Chemistry

**Grade level/band**: 11–12

**INSTRUCTOR PROCEDURES**

1. **Task overview:**

Students explore the subject of antioxidants and their benefits to humans. Students research the reaction between antioxidants and free radicals and must decide how this reaction is related to basic chemical bonding. Students summarize their research in a 2-page paper.

1. **Prior knowledge required:**

Students should be able to:

* Write down the chemical formula for diatomic and polyatomic systems.
* Write the electron configuration and the number of valence electrons for each atom in the molecule.
* Cite sources in text and in a Works Cited page.

1. **Common Core State Standards aligned to this task:**

[CCSS.ELA-Literacy.RST.11-12.1](http://www.corestandards.org/ELA-Literacy/RST/11-12/1/) Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

[CCSS.ELA-Literacy.RST.11-12.2](http://www.corestandards.org/ELA-Literacy/RST/11-12/2/) Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

[CCSS.ELA-Literacy.RST.11-12.3](http://www.corestandards.org/ELA-Literacy/RST/11-12/3/) Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

[CCSS.ELA-Literacy.RST.11-12.4](http://www.corestandards.org/ELA-Literacy/RST/11-12/4/) Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

[CCSS.ELA-Literacy.RST.11-12.5](http://www.corestandards.org/ELA-Literacy/RST/11-12/5/) Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

[CCSS.ELA-Literacy.RST.11-12.6](http://www.corestandards.org/ELA-Literacy/RST/11-12/6/) Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

[CCSS.ELA-Literacy.RST.11-12.7](http://www.corestandards.org/ELA-Literacy/RST/11-12/7/) Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

[CCSS.ELA-Literacy.RST.11-12.8](http://www.corestandards.org/ELA-Literacy/RST/11-12/8/) Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

[CCSS.ELA-Literacy.RST.11-12.9](http://www.corestandards.org/ELA-Literacy/RST/11-12/9/) Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

1. **Time requirements:**

This assignment is completed outside of class. Allow one week for this writing assignment.

1. **Instructor materials to use during administration:**

* Any introductory general chemistry textbook (Chang, Zumdhal, or Oxtoby)
* Any introductory organic chemistry textbook
* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249911/
* http://www.healthchecksystems.com/antioxid.htm

1. **Instructor procedures during administration:**

* Give specific examples of complex reactions between two molecules.
* Introduce Lewis dots for simple homo diatomic molecules (e.g., H2, N2, O2).
* Then introduce Lewis structure for hetero diatomic molecules (e.g., HCl, NO, CO).
* Then introduce Lewis structure for polyatomic molecules (e.g., H2O, NH3, BF3, CCl4, CH4, PCl5, SO3, CO2, PCl5).
* For each category, students should be asked to come up with the number of valence electrons, draw Lewis dots, and establish if the octet rule is obeyed.
* Use VSEPR model to predict the electron distribution and molecular shape.
* Class discussion: When comparing a bond angle of 90° (resulting in a square planar geometry arrangement) to a bond angle of 109.5° (resulting in a tetrahedral arrangement), why is the tetrahedral arrangement more common?
* Predict the net dipole moment of H2O, CH4, CCl4, and CH3Cl. Draw the direction of the net moment in each case.
* Invoke resonance structure for molecules such as SO3, NO3-, SO42- etc.

1. **Student support:**

The following suggestions are examples of scaffolding that can be used to meet the diverse student needs within the classroom.

* Provide class time for research on students’ topics.
* Provide definitions of new vocabulary words ahead of time.
* For the final product, all learners will benefit from peer assistance while brainstorming their topics, as well as a peer- or teacher-edit of their papers before final submission.
* Some students will have good research skills, but some will need guidance in the determination of appropriate sources and where to look for them. It is important to spend class time in review of what constitutes an appropriate source in advance of students’ independent work time.

1. **Extensions or variations:**

* Students could present the results of their research to the class via an oral or multi-media presentation.
* A panel could be organized where students discuss the different illnesses they researched.

1. **Scoring and assessment considerations:**

EPIC developed the *College and Career Ready (CCR) Task Bank Scoring Rubric* to accompany this task. If your school or department uses a standardized rubric that would fit the content and requirements of this task, you may choose to use your existing rubric. The following notes and suggestions are meant to clarify the intent of the rubric and include considerations for the assessment of student work.

* When assigning the task, provide students with the rubric that will be used to score their final product and discuss it as a class.
* Unlike some rubrics, the *CCR Task Bank Rubric* does not predetermine “point values” for the scoring criteria. The rubric thus allows for flexibility with different instructors’ scoring systems and individual determination of the “weight” of each criterion.
* Student work that scores at the *Accomplished* level is considered to be entry-level college work.
* The *Exceeds* category on the rubric provides an example of how a student can go above and beyond the *Accomplished* level. These examples are intended to be only ONE way a work product can exceed expectations, thus allowing room for your professional judgment.
* If needed, consider including task-specific criteria as an additional scoring category to the rubric or providing a checklist of requirements for the task.