**Foundation LO #1: A Stable Monomeric SiO2 Complex with Donor-Acceptor Ligands: Foundational examination of Lewis dot structures and bond enthalpies**

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**Description:**

This module offers students in an introductory chemistry or foundational inorganic course exposure to recent literature. Students will apply their knowledge of Lewis dot structure theory and basic thermodynamics to compare and contrast bonding in SiO2 and CO2.

**Learning Objectives: Students should be able to:**

1. Describe the bonding in SiO2 and related compounds (CO2)
2. Use Lewis dot structure theory to predict bond orders
3. Apply bonding models to compare and contrast bond types and bond energies (sigma, pi)
4. Characterize bond strengths based on ligand donors

**Questions**

1. Draw Lewis dot structure for CO2 and identify how many σ and π bonds are present.
2. Draw Lewis dot structure for SiO2 and identify how many σ and π bonds are present.
3. What is the geometry around the central atom in each of your answers to questions 1 and 2?
4. What is the hybridization of each atom in CO2 and SiO2?
5. Given the following bond strengths, what trend do you observe? Explain the origins of this trend.

C-H 416 kJ/mol

Si-H 326 kJ/mol

Ge-H 289 kJ/mol

Sn-H 251 kJ/mol

Bond energies from Housecroft and Sharpe 4th Ed.

1. Do you expect a C-O or Si-O bond to be stronger? Why?
2. Look up the reported C-O and Si-O bond strengths. How do these compare to your predictions?
3. Do you expect a C-O or C=O bond to be stronger? Why?
4. Look up the reported C-O and C=O bond strengths. How do these compare to your predictions?
5. Do you expect a Si-O or Si=O bond to be stronger? Why?
6. For silicon-oxygen bonds, the single bond is reported to be 466 kJ/mol and the double bond is reported to be 642 kJ/mol. How does this compare to your predictions?
7. Calculate the energy required to break the following:

a. Four C-O single bonds

b. Four Si-O single bonds

c. Two C=O double bonds

d. Two Si=O double bonds

Looking at the difference in energy between the single bond and double bond for C and Si do you think these elements will prefer to make two double bonds or 4 single bonds in their compounds?

1. In the paper, the researchers were able to isolate a compound that contained SiO2.  Explain why this is an important result.
2. Watch the following clip from the original Star Trek <https://www.youtube.com/watch?v=IpZ9_i3DEbU>. Why are Dr. McCoy’s concerns valid?