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Faculty Guide for the in-class activity: "Lewis Structure Challenge"

Time Required: One class period

Set-up: Small groups of students (ideally 3-4 per group), but actual group size can be determined at the discretion of the instructor.

General instructions:

The competition involves students working collaboratively within their groups to draw Lewis structures for hypothetical molecules. In successive rounds of competition, the instructor assigns criteria for the compounds to be drawn as outlined in the table below. The students then choose *non-metal* elements from the Periodic Table and attempt to construct valid Lewis structures that satisfy the criteria within a limited timeframe. Points per round are awarded for correct structures (all or nothing) with bonuses based on identifying ideal geometry and formal oxidation states. Each round should be timed (to be determined by the instructor, but generally 2-3 minutes in order to add a time-pressure facet to the competition). After time has been called in each round, structures should be shared with the instructor for discussion and immediate awarding of points. At the instructor's discretion, groups can challenge each other to provide ideal geometries, formal oxidation states, resonance forms, etc. In these cases, bonus points may be awarded to either or both of the "challenging" or "challenged" groups.

Definitions:

Elements - This refers to the number of different *elements* allowed per molecule or ion.

Atoms - This refers to the total number of *atoms* allowed per molecule or ion.

Scoring: 5 points per correct answer per round, with partial credit dispensed at the discretion of the instructor.

Round	Elements	Atoms	Examples
1	1	1	Ar, Xe, Cl^-
2	1	2	F_2, Cl_2, N_2
3	2	2	HCl, ClF, NO
4	2	3	H_2O, OF_2, NO_2, N_2O

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5	2	4	NH_3, BH_3, SO_3
6	2	5	CH_4, XeF_4, SF_4
7	2	6	PF_5, IBr_5
8	2	7	SF_6, PF_6^-
9	3	3	HOCl, OClF, HSBr
10	3	4	$HNCl_2$, H_2NF, O_2NF, BF_2Cl
11	3	5	CH_2Cl_2, etc…

Additional rounds can be added as desired, depending on class length.

Notes:

1. This exercise should be implemented *after* the instructor has introduced and explained Lewis structures and their significance, including rules for drawing them correctly, determining ideal geometries, etc.

2. Since students are choosing elements from the Periodic Table on their own, there may be significant variance in the sorts of compounds they create. Since this exercise is intended to reinforce the tenets of valence electron counting and bonding, it is not important that students create "known" compounds. As long as the compound does not violate the basic structural rules, it is acceptable in the context of this contest.

3. The table above illustrates a stepwise progression from simple to complicated molecules. At the instructor's discretion, the levels and sublevels can be arbitrarily mixed in order to create a randomized set of criteria rather than an orderly progression.

4. If desired, the instructor can restrict the students' answers to neutral molecules or ions, or even run the competition in two tiers, e.g., first neutral molecules and then ions.

5. After any round (most likely to be effective after a few rounds of play when most teams should have collected points), the instructor can allow inter-team challenges. These consist of team "A" asking team "B" to answer questions about either of the teams' Lewis structures from that round. If the challenged team (team "B") fails to answer correctly, 3 points are

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subtracted from their total and transferred to the challenging team (team "A"). Correct challenge questions earn 3 bonus points for the challenged team.

Challenge questions can include

- assigning formal oxidation states of specific atoms
- specifying ideal geometry for a compound
- describing and explaining likely defects from ideal geometry
- identifying the presence (or lack) of resonance structures
- etc.