

# CASE TEACHING NOTES

## for

### "Avogadro Goes to Court"

by  
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We have taught this case three times in our general chemistry course, and each time the students have responded in an enthusiastic and positive manner. They clearly enjoy the challenge it presents. The case has been taught in a 75-minute recitation period and we have found this time to be more than adequate for our four-student teams to design the needed experiments, execute them, and complete the required calculation.

Since the case deals with the concepts of Avogadro's number and the mole, which are relevant to nearly all introductory level science courses, it may be suitable for use in chemistry courses for non-science majors, general science courses, and, perhaps, some introductory level biology courses in addition to general chemistry.

The *Wall Street Journal* article cited here inspired this case study. We felt that a situation in which students had *successfully* sued their professor could not fail to be of interest to other students, and that offering our students the challenge of trying to do what another group of students had failed so dramatically to do would provide them with a strong incentive to complete our fictional Professor Schroeder's assignment.

A good way to begin a class discussion of this case is to ask the students what differences they see between the fictional case study and the actual incident reported in the *Wall Street Journal* article. A discussion of why the fictional and the real judge may have ruled differently can be productive and insightful.

We have structured this case in such a way that our students are required to design experimental procedures that will allow them to gather the data, the mass of aluminum present in the roll, needed to complete the assignment. The student teams must realize that two simple experiments—determining the area of the aluminum foil sample that they are provided and determining its weight—will provide them with the data that they need to do the required calculation. Each of these measurements must be made to at least three significant figures to allow the calculations to be done to the required three significant figure accuracy. A meter stick and a relatively simple laboratory balance will suffice for this purpose. Requiring the students to plan these experiments on their own is a departure from the cookbook procedures to which beginning chemistry students are all too often exposed. Details of the calculation are provided in the [answer key](#).

Additional teaching aids designed to make the abstract concept of Avogadro's number more concrete and accessible for students who have difficulty dealing with the enormity of this number are readily available (Diemente, 1998; Goh, 1994).

Some of our teaching objectives for this case follow:

1. **Avogadro's number.** This case allows our students to use the seemingly abstract concept of Avogadro's number in a concrete way to carry out a cost calculation. Avogadro's number,  $6.02 \times 10^{23}$ , the number of particles, atoms or molecules that make up one mole of any substance, is so large that it is only an abstraction for many beginning chemistry students. This case requires students to use the mole concept (see below), yet to think in terms of an individual atom. This combination of modes of thought contributes to making the significance of Avogadro's number more concrete.
2. **The mole.** We seek to help our students realize that while a mole is a unit of mass, like a pound or a kilogram, it is more fundamentally a counting measurement like a dozen or a gross, and that it is the mass of the individual particles in the count that determines the mass of the mole. Since the particles of concern in this case study are aluminum atoms, each having a mass number of 26.98 atomic mass units, a mole of aluminum has a mass of 26.98 grams.
3. **Significant figures.** The case is designed to make students aware that all of the data that they acquire must be of at least three significant figure accuracy if they are to calculate the cost of a single aluminum atom to that accuracy. To do this, they must determine the size and mass of the aluminum foil section they are given to at least three significant figure accuracy. It is well to discuss the inappropriately large number of significant figures reported in the calculation attributed to Professor Zahn.
4. **Unit conversions and dimensional analysis.** We seek to increase our students' awareness of the need to document the methods used to inter-convert the units used in their calculations. The calculations for this case involve a number of unit conversions. Our experience indicates that without a systematic unit analysis, the dimensions of the answer that they arrive at may be unclear to them.

## ANSWER KEY

Answers to the questions posed in the case study are provided in a separate answer key to the case. Those answers are password-protected. To access the answers for this case, go to [the key](#). You will be prompted for a username and password. For the username and password, contact the National Center for Case Study Teaching in Science administrator at [answerkey@sciencecases.org](mailto:answerkey@sciencecases.org).

## REFERENCES

- Diamente, D. 1998. Demonstrations of the Enormity of Avogadro's Number. *Journal of Chemical Education* 75(12): 1565-6.
- Felsenthal, E. 1995. Avogadro's Number, You Say, Professor? I Don't Think So. *The Wall Street Journal Eastern Edition* May 9: A1.
- Goh, N. K., Subramanian, R. and Chia, L. S. A More Direct Feeling for Avogadro's Number. *Journal of Chemical Education* 71(8): 656-7.