

Case Study Development as a Learning Strategy for Senior Chemistry Students

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Who are we serving?

- Many students enter with little understanding of what chemistry is.
- Many students taking chemistry courses are there "because they have to" for their degree.
- Those who do choose a chemistry degree often do so because 'it was their best mark in high school'.



A traditional approach to teaching chemistry

Teach the models and theory
(equations, structures, patterns, lists)



Demonstrate the chemistry



Put chemistry in context

"You can't teach electronic spectroscopy without first understanding bonding, before learning functional groups and standard nomenclature."

Chemistry at King's

Social and environmental responsibility

Scientific intuition

Professionalism:
communication, teamwork, organization

Independent and critical thinking

Skills and content knowledge

What makes scientific learning engaging and relevant?

'Active learning'
'Relevance to student's lives'
'Independent learning'

Chemistry at King's

Rich context learning:

Teach from the context rather than from the content.

Context of the chemistry



Observe the chemistry



Teach the models and theory
(equations, structures, patterns, lists)

Case studies: a tool for rich context learning

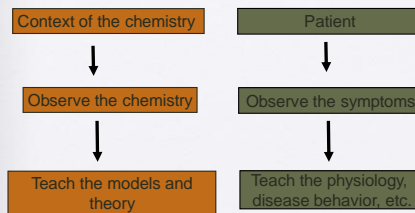
"Cases are stories with a message. They are not simply narratives for entertainment. They are stories to educate."

Herreid, C.F. What is a case? Bringing to science education the established teaching tool of law and medicine. *J. Coll. Sci. Teach.* **1997**, 27, 92-94.

Case studies have become a dominant teaching tool in schools of law and medicine.

Rich context learning: case studies in medicine

Teach from the context rather than from the content.



ie. PBL at U of A

Using case studies in introductory chemistry

CHAPTER 2 Building Blocks of Materials

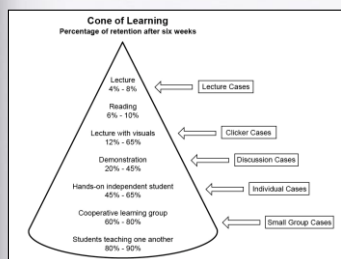
Outline

- 2.1 Falsely Positive? The Chemistry of Drugs in Sport
- 2.2 Classifying Matter
- 2.3 Three Levels of Operation: Observable, Molecular, Symbolic
- 2.4 Elements and their Atoms
- 2.5 Compounds
- 2.6 Chemical Reactions, Chemical Change
- 2.7 Protons, Electrons, and Neutrons: Ideas about Atomic Structure
- 2.8 Isotopes of Elements
- 2.9 Relative Atomic Masses of Isotopes and Atomic Mass Units

2.1 Case Study: Falsely Positive? The Chemistry of Drugs in Sport

In 2006, Floyd Landis, the winner of that year's prestigious Tour de France bicycle race, was accused of using performance-enhancing drugs. Urine samples collected after his dramatic victory in the mountains, 200 km high, 17 of the race were alleged to have elevated levels of testosterone, a male sex hormone that builds muscle and improves stamina. Following an unsuccessful appeal to the Court of Arbitration for Sport, Landis was stripped

What makes scientific learning engaging and relevant?



The Cone of learning as first developed by Dale, was revisited by Lord in 2007. The application to case study education comes from Herreid.⁹

Dale, E. *Audio-visual methods in teaching*. Dryden Press, New York, 1969.

Lord, T. "Society for College Science Teachers: Revisiting the Cone of Learning—is it a Reliable Way to Link Instruction Method with Knowledge Recall?" *Journal of College Science Teaching*, 37, 2007, 14-17.

Herreid, C.F. "What's Next for Case Study Teaching in Science?" 2011 Spring ConChem: Case-Based Studies in Chemical Education.

A challenge and an opportunity



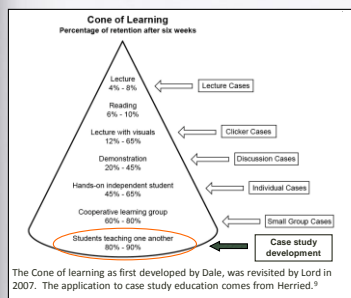
If students are exposed to rich context learning in first year, they come to expect it in senior years.

The students are equipped to see chemistry in context.

Goals of case study development

- Have students learn through independent development and teaching.
- Have students think about the way science is taught.
- Improve students written and oral presentation skills.
- Develop deep and lasting knowledge about an area of chemistry.

Case study development as a tool for learning



Dale, E. *Audio-visual methods in teaching*. Dryden Press, New York, 1969.

Lord, T. "Society for College Science Teachers: Revisiting the Cone of Learning—is it a Reliable Way to Link Instruction Method with Knowledge Recall?" *Journal of College Science Teaching*, 37, 2007, 14-17.

Herried, C.F. "What's Next for Case Study Teaching in Science?" 2011 Spring ConfChem: Case-Based Studies in Chemical Education.

Project design

- First lab period: What is a case study?
- Sept 17: Select a topic and write a 1 page summary
- Oct 1: Outline of the case study and chemistry along with a list of references
- Oct 22: Draft 1 due
- Oct 27: Presentations
- Nov 12: Draft 2 due
- Nov 26: Final Draft due

What is a case study?

A good case tells a story.

A good case focuses on an interest arousing issue.

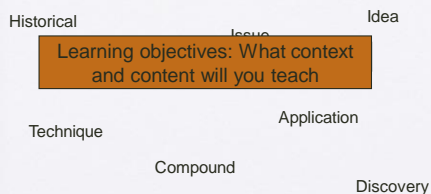
A good case is set in the past five years.

A good case includes quotations.

A good case creates empathy with the central characters.

Herried, C.F. What makes a good case? *J. Coll. Sci. Teach.* 1998, 27, 163-165.

Choosing a topic



Writing

Your case study must show that you have done some **independent research** into the area you choose. It must contain a chemical theme that serves to highlight an important concept in inorganic chemistry. There is no page limit but anything less than 10 pages will most likely not be adequate. There are many great resources available in the library and many books dealing with interesting topics. It is expected that you create your own case study **based on books, journal articles and texts**. Online resources and other case study books may be used to guide you but you must show unique research in the scientific literature.



Presenting
Peer reviewing
Editing

The case studies

- Class of 8, 2nd and 3rd year students (1 Environmental studies, 1 Biology, 6 Chemistry)
- Focused on inorganic chemistry
- Designed for first year students
- Formatted into booklets with story, content, questions, examples.

The case studies

Photography and creation of black and white, color, and digital images

Photochemistry, molecular orbital theory, energy levels

Original draft by Jesse Vanderveen (3rd year BSc), Developed by Katelynn Mailli (3rd year BSc)

The Chemistry of Photography - 1801 Theory into photographic practice, with the amazing world of Spectral
PHOTOCHEMISTRY
 January 2011 The King's University College

A tale of 12 Johns...
 The year is 1782, and, in a highly competitive world, a young Englishman is getting his portrait painted in front of the King.

We take an ironic journey to the everyday show, but have done the things 'regularly' get captured onto our screens? It's not something you often think about, but it's something you can explain the 'why'?

Original draft by Jesse Vanderveen (3rd year BSc), Developed by Katelynn Mailli (3rd year BSc)

Industrial chemistry, manufacturing processes, chemical engineering

Acid and base chemistry

Original draft by Katelynn Mailli (3rd year BSc), Developed by Katelynn Mailli (3rd year BSc)

Hydrogen, pH, and litmus paper... is there anything else?
ACIDS AND BASES
 C and E News!

Check out these links:
 • Chlorides and Chlorates
 • Chlorine
 • Chlorine and Chlorides
 • Chlorine and Chlorates
 • Chlorine and Chlorides
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Original draft by Katelynn Mailli (3rd year BSc), Developed by Katelynn Mailli (3rd year BSc)

Neil Bartlett's discovery of the reactivity of noble gases

Noble gases, electronegativity, VSEPR, and ionization energies

Original draft by Cassidy Vanderveen (2nd year BSc), Developed by Katelynn Mailli (3rd year BSc)

NOBLE GASES
 January 10, 2011

Traveling to the moon, breathing underwater, reacting noble gases - all these, which come to you first in your mind?

The answer? None of them!

Original draft by Cassidy Vanderveen (2nd year BSc), Developed by Katelynn Mailli (3rd year BSc)

Arsenic poisoning in Bangladesh

Speciation, chemistry of arsenic, biological chemistry

Original draft by Katrina Conals (3rd year BSc), Developed by Katelynn Mailli (3rd year BSc)

speciation
 no one could ever have predicted such consequences.

Original draft by Katrina Conals (3rd year BSc), Developed by Katelynn Mailli (3rd year BSc)

Through the Looking Glass[®], and discovery of Cisplatin[®]

Stereochemistry, chirality and 3-dimensional chemistry

Original dish by Katelynn Nadill (3rd year BSc), Developed by Katelynn Nadill (3rd year BSc)

Did we achieve rich context learning?

"I loved this class we learned all sorts of diverse types of chem. And I will probably retain the knowledge I have learned for my entire life – I loved this class!"

"Liked the case study assignment."

"Writing the case study as well as the group presentations really helped to immerse myself in the content of the course."

Acknowledgements

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