Top-Down Teaching in Chemistry:
A Stylistic Change in Teaching to Promote Student Engagement

TA Scholar: Geoff Thomas  
Faculty Mentor: Laya Kesner

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BACKGROUND

- Traditional Bottom-Up teaching is conducted by establishing and building upon basic principles. This methodology has historical precedence and is currently more commonly used in science courses.

- Often times the least captivating material is the first impression a student gets of the lesson.

- Top-Down teaching works by breaking down familiar, complex ideas. While this method is less common in modern scientific curriculum, it can be hypothesized that this is potentially a more powerful form of learning.

- Top-Down methodology mimics a natural learning process where a natural phenomenon is observed and then broken down until the basic principles and reasons for its actions are discovered.

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THE PROJECT

- Approach lesson design in a stylistically different manner while covering the same material
- Start with a “Real-Life” example and build down to core concepts
- Ask the students questions
- Discuss students’ possible theories and hypotheses and reason through these
- Act as a moderator and guide the discussion in the appropriate direction
- Here the methodology is implemented in an elementary chemistry discussion / lab section (CHEM 1120)

Examples

- Ester synthesis
  - As a way of introducing ester synthesis to students, we investigated the chemistry of smell. The lesson started by passing around a collection of chemical compounds with distinctive smells (Esters, Aromatics, Thiols, Amines, etc.) and asking the students “Why do we smell?” “How does smell work?”

- Chromatography
  - TLC (Thin Layer Chromatography) is a common method of analyzing mixtures of compounds in organic chemistry. To introduce how this method works, the word “CHEM 1120” was drawn in permanent marker on the instructor’s arm and the students were asked “What makes a ‘Permanent marker’ permanent?” as various solvents were used to try to remove the writing.

- Oxidation of alkenes
  - Alkenes are a chemical functional group present in a wide variety of compounds. Dyes are one class of familiar compounds where alkenes are most visible. As such, to introduce oxidation of alkenes to the class, a bright blue shirt was hung on the board and bleach was poured on it. As the color leached out of the bleach stain the class was posed with the question: “Why does this happen?”

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ASSESSMENT & BENEFITS

- Benefits of Top-Down methodology
  - Higher attendance
  - Increased class popularity
  - Improved knowledge retention through memorable learning experiences
  - Engaged students in class discussions and lessons
  - More questions asked by students
  - More personal class experience for students
  - Teaches students how to critique scientific ideas
  - Positive course feedback as students learn and benefit from a superior teaching environment
  - Improvement in test scores throughout the course

Evaluation

Top-Down teaching may not be the most effective means of instruction in every instance, however, it represents a powerful tool in an instructor’s repertoire that is currently underused.

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References for project development

2. Personal Interview with Tadhg P Begley Ph.D. (Texas A&M University)