CHEMmunicate

A chemical structure drawing game for building scientific communications skills and enhancing engagement of first year students

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Introduction

Gamification has been shown to be effective in education.[1]

- Increases motivation and engenders a fun learning environment
- Develops adaptability and responsiveness skills[2,3]

Engagement is known to have a large effect on student attainment.[4]

- Educators should provide stimulating in-person environments[5]

Motivation

- Engagement among undergraduate students has been decreasing over recent years, especially post COVID
- As Senior Tutors, we are developing strategies to improve engagement and build a cohesive learning environment
  - Therefore, we have introduced new sessions for Stage 1 undergraduates termed "Senior Tutor Check-Ins"

CHEMmunicate: The Game

- Ca. 10-20 Stage 1 UGs are split into two teams who play against each other in a new game: CHEMmunicate
- Similar to "Guess Who?", the game involves identifying chemical structures using simple Yes/No questions
- CHEMmunicate also has direct learning relevance through building students' chemistry vocabulary and ability to describe structural features

How to Play

Step 1: Students Assigned Roles within their Group

"Responder"

1 student given structure & answers Y/N to questioners

"Scribe"

1 student draws structure according to the answers

"Questioners"

Other students ask Y/N questions to work out structure

Step 2: The Game Ensues…

Questioners ask Y/N question → Responder answers Y/N after checking card → Scribe draws structure on whiteboard → Questioners ask Y/N question …

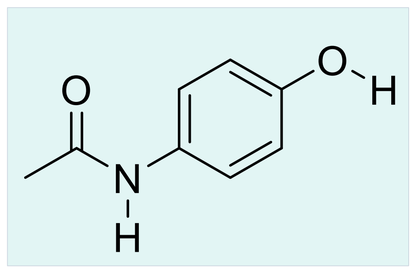
Role of the Session Leaders (One per group)

- Support use of scientific vocabulary
- Encourage participation and build enthusiasm
- Help responder and scribe
- Provide helpful tips to keep the game moving

Step 3: And the Winner is…

Winning team first to draw the correct structure → Post-game discussions give opportunities for additional learning

Example: Paracetamol



Students are provided with the molecular formula at the start

Structural Features & Functional Groups

Example Qs:

- Is there an amine? (No)
- Is there an amide? (Yes)
- Are there any rings? (Yes)
- Is there an aromatic ring? (Yes)
- Is there a carbonyl group (No)
- Is there a hydroxy group (Yes)…

Prompts from Session Leaders:

- What functional groups do you know that contain a nitrogen?
- How could the carbon atoms be arranged? Must they always be in a chain?

Learning Goal: Promote the use of chemical terminology (e.g. functional groups, avoid "is this bonded to that?")

Connectivity

Example Qs:

- Is the amide bonded to the arene through the N? (Yes)
- Is the amide situated at the *para*-position? (Yes)…

Prompts from Session Leaders:

- What positions on aryl rings do you know?
- What about if we give the carbon atoms numbers?

Learning Goal: Encourage atom numbering, demonstrating the value of IUPAC nomenclature. Avoid "is this atom bonded here?".

Topics for Post-Game Discussions:

- What is this molecule used for?
- This is an acidic molecule. Where would it be deprotonated? First?

Other potential topics:

- Aromaticity?
- Synthesis? Reactivity?...

Outcomes

Provided opportunity to meet cohort in an informal setting

- Improve confidence of students to approach us going forward

Game builds communication skills and learning community

- Attendance good and student feedback very positive

References [1] Kapp, K. M. *"The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education."* Wiley, **2012**; Vol. 4, 81. [2] Richter, G.; Raban, D. R.; Rafaeli, S. in *Gamification in Education and Business*; Springer: Cham, Switzerland, **2015**, 21. [3] Samide, M. J.; Wilson, A. M. *Chem. Educ.* **2014**, *19*, 167. [4] Kuh, G. D.; Cruce, T. M.; Shoup, R.; Kinzie, J.; Gonyea, R. M. *J. Higher Educ.* **2008**, *79*, 540. [5] King, S. M. *J. Chem. Educ.* **2023**, *100*, 243.