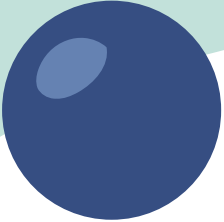




Enhancing Student Visualization of Primary Stabilizing Forces Through 3D Protein Models

By: Aine Flynn



Overview

Project Format

- Interactive lesson plan for an undergraduate Biochemistry course (BC 351 *Foundations of Biochemistry*)

Topic

- Protein structure/folding

Goals

- Experience
 - Facilitate hands-on learning, clear up content misconceptions
 - Contribute to current research on effective teaching strategies (Science)
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Inspiration

- Since childhood, I was drawn to teaching
- Leadership & teaching positions
- Helping others
- Admiration for teachers
- Wanted to explore career of professors
- Stepping stone in career towards OT



Personal Preconceptions on Effective Teaching

Based on my personal experience as a student, I believe teaching should be...

- 1) Visual
 - a) Images/graphs/videos
 - b) Drawing out processes/figures
 - c) Fill-in notes
- 2) Engaging
 - a) Hands-on activities
 - b) Relevance/applicability
- 3) Straightforward
 - a) Not too over complicated/busy
 - b) Experts vs students

Theory – Literature Review

Pedagogy

Bradford– *How People Learn*

Doyle– *Helping Students Learn in a LCE*

Lang– *Small Teaching*

Biochemistry

Sholders– *Principles of Biochemistry*

Harle– *External Representations*

Robic– *Ten Misconceptions*

Wu– *Exploring Visuospatial thinking in chemistry learning*

Harle– *Students' understanding of primary and secondary protein structure*

Marshall– *Pipecleaners & Pony Beads*

Herman– *Tactile Teaching*

Project Design

Topic Selection

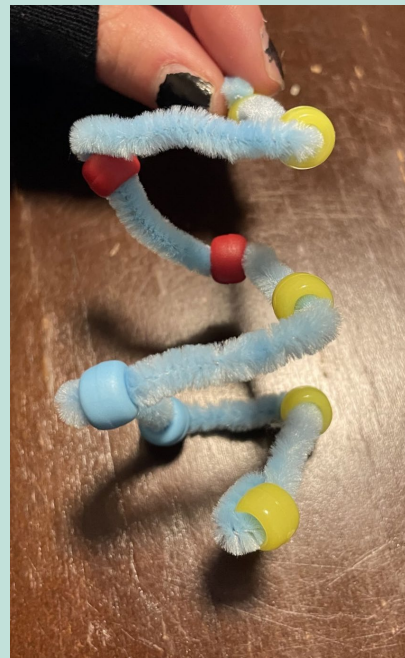
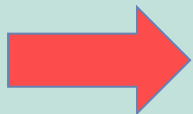
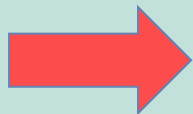
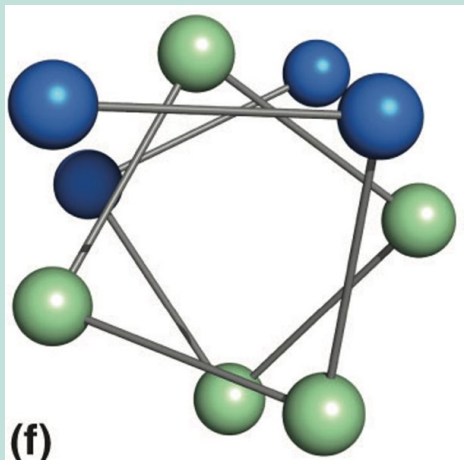
- Pre/post course evaluations

Worksheet

- Learning objective: Compare and contrast the interactions driving the formation of secondary, tertiary, and quaternary structure of proteins
- Guided instruction & prompts/questions on worksheet
 - Individual, partner, group, & whole class work
- iClickers = checkpoints

3D Protein Model

- Adaptation of Dr. Sholder's helical wheel diagram
- Pipe cleaners = protein backbone
- Pony beads = amino acids (C-group)
 - Colors correspond to side chain properties



Project Implementation

Flip Class

- Before Class– Watch last year's Echo360 recording, take notes
 - Goal: have context on topic before starting activity
- During Class– Have students construct primary, secondary, and tertiary protein structure levels
 - Circulate room and answer questions as needed

Evaluation

- iClickers
 - Student understanding
 - Effectiveness of teaching strategies/use of 3D model

Data Analysis – iClickers 1 -3



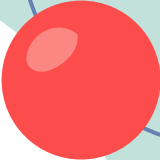
89%

Understood primary protein
structure/interactions

90%

Understood secondary protein
structure/interactions

50%



Understood how amino acid
sequence (particularly side
chain interactions) in primary
protein structure facilitate
protein folding into secondary
structure



Data Analysis – iClickers 6 – 8

78%

Have used physical objects to
model molecular interactions
prior to my Thesis project

>50%

Benefitted or was not
impacted from the use of my
particular 3D protein model

>50%

Would use physical objects to
model molecular interactions
again

Potential Benefits

Personal

- Experience designing, teaching, and reflecting on my lesson plan
- Practical applications for my career
 - Communicating science in an informal setting
 - Taking complex information & teaching it in a interactive/digestible way

People Within my Field

- Contribute to field of research pertaining to use of physical models in undergraduate Biochemistry courses
 - Specific, replicable model with corresponding worksheet

People Outside of my Field

- Lesson plan implements range of pedagogy strategies; could be useful for any field/topic
- Creative aspect (3D protein model) could encourage visual/interactive activities
- Encourages teacher engagement through use of wide range of communication strategies
- Encourages learners (in any context) to practice metacognition and variety of learning tools



Limitations/Caveats

Time Management

- Activities too detailed to be completed in 50-minute lecture period
 - Didn't get to tertiary structure or new understandings
 - Didn't answer iClickers 4 or 5
- Video as supplement

Assessment/Evaluation

- Pre and mid course evaluations originally intended to be used as assessment
 - Simplified model design → learning objective did not align with pre/mid course evaluation questions
- iClickers = inconsistent
 - 1-3 covered during lecture in which lesson plan was taught
 - 4-5 not covered
 - 6-8 covered during lecture following instruction of lesson plan
 - Offer indications of effectiveness of teaching strategies, but no solid conclusions

Flexibility of Material

- Pipe cleaners too flexible
 - Students struggled with materials rather than understanding content of lesson



Future Research

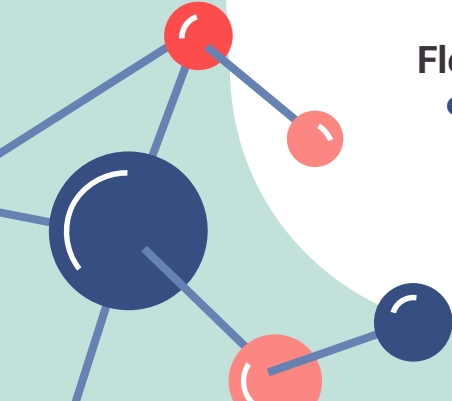
Time Management

- Be mindful of duration of class
 - Spread lesson over multiple lectures, or modify it to fit allotted time

Assessment

- Design pre/post topic assessments for more quantifiable measurement of student achievement

Flexibility of Material

- Perhaps use Mini Toobers
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**Thank
you!**