TRANSLATÖR: The 3D Printed Game of Protein Translation

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Project Abstract

Protein synthesis at the cellular level is a complex process with profoundly different interactions from those in the macro-scale world. The one way for learners to grasp such complex interactions at nano-scale is to enlarge entities and to scale-up processes by using 3D models. **TRANSLATÖR** is a game originated by the PAR lab and adapted by the 3D SIG (Special Interest Group). The game allows students to play in groups working with 3D models simulating physical interactions a cell undergoes during protein synthesis. **TRANSLATÖR** is entirely 3D printed, allowing for schools to be able to print out the game for use. The concept of distributing printable models displays the potential of 3D printing in STEM and engineering education.

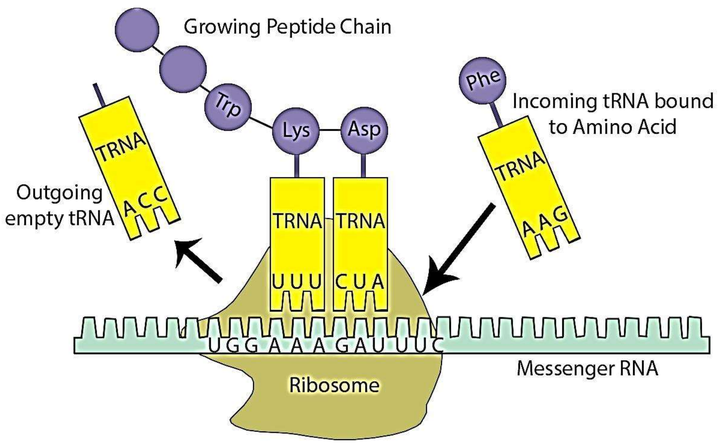
Challenges

- Develop novel, engaging teaching tools for Generation Z engineering students.
- Physically mimicking the synthesis process that occurs in the cell with the game pieces posed a significant problem, especially with the polypeptide synthesis at the ribosome.
- Designing the game pieces so that they are easy to play with and not a burden to use.
- Ensuring pieces would be strong enough to hold up, especially over a long period of use.
- Modeling the pieces with the printer tolerances and limitations in mind.

Our Approaches

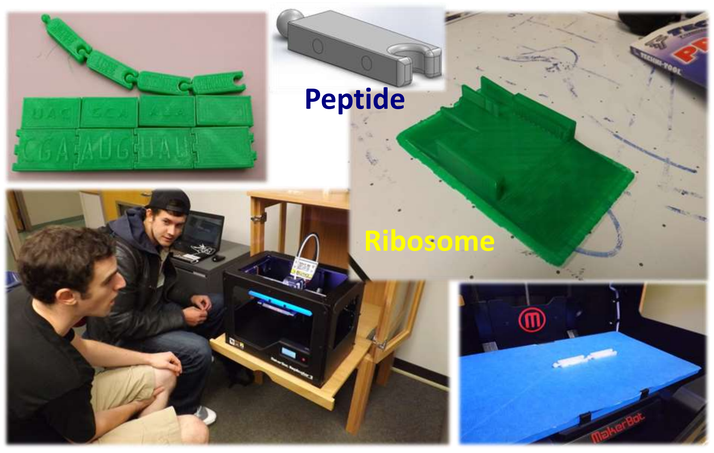
Proposed solutions to resolving the challenges are as follows:

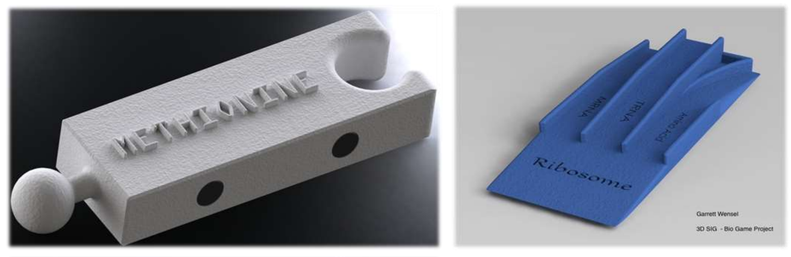
- Use novel technologies to develop engaging teaching tools for *Generation Z* engineering students.
- To mimic molecular affinity, the m-RNA and T-RNA are to use magnets to bond together to make game play easier.
- The methionine needed to rotate and move easily so a “ball and socket” design was adapted.
- A ribosome is designed to break apart the pieces as the amino acid was pushed through.
- Pieces have to be designed with structural support in mind to withhold vigorous use.

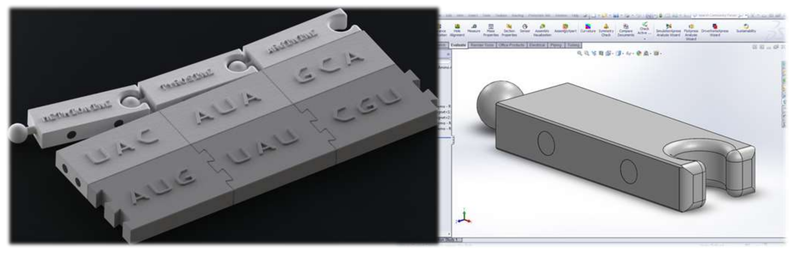


Institutional Objectives

- Hands-on engineering education
- Nano/micro-scale systems engineering
- Integration of biological systems knowledge in engineering curriculum and education
- Teaching fundamentals of digital and additive manufacturing and 3D printing tools
- Exposure to rapid prototyping tools

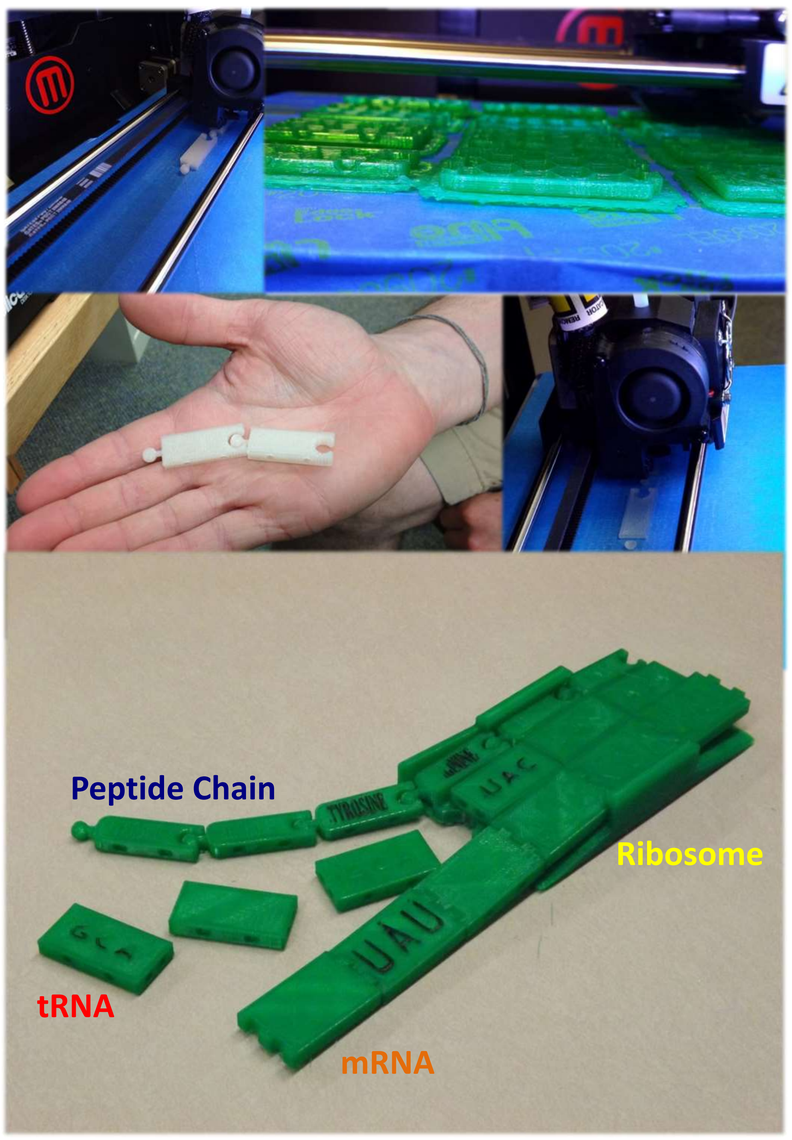






Potential Assessment Methods

- In-class activity is a formative assessment technique for strong peer-to-peer learning.
- Low-stake assessments create an easier learning environment for students.
- Review of 3D printed physical objects.
- Peer-review and presentations



Broader Impact

- 3D printing is a new and rising industry with vast potential in engineering education and practice. **TRANSLATÖR** is a prime example of the potential in the 3D printing industry.
- Easy way to provide hands-on experience to engineering students.
- Illustrates the ease of exchanging 3D models, leading to a new venue for technical communications.
- Prototyping and testing is faster and cheaper than using molded plastics.
- Consistent with the easy ‘reset’ and “redo” experience and expectations of Generation Z

Program Objectives

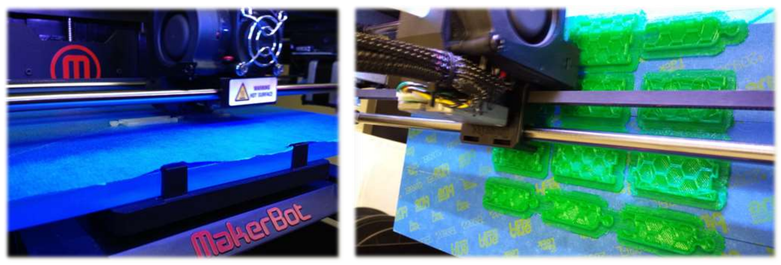
By using **TRANSLATÖR** as a teaching tool, students will:

- Learn though hands on and visual interaction of the interworking of protein production in the biological cell.
- Engage in social interaction by working in groups to play the game, creating a positive and educational learning environment.
- Achieve mastery in the core curriculum for Living Environment classes.

Expected Outcomes

Criterion 3. Program Outcomes: ABET Board - ABET a-k (Nov. 2008):

(a) apply knowledge of STEM,
(c) design a system, component, or process,
(d) function on multidisciplinary teams,
(e) identify, formulate, and solve engineering problems,
(f) professional and ethical responsibility,
(j) contemporary issues, and
(k) use the techniques, skills, and modern engineering tools.



Program Outcomes

- Research Experience (RET) for Karen Cook
- Massena Central High School plans to use the game as a hands-on teaching tool.
- **TRANSLATÖR** is an engaging game.
- Nano/micro-scale systems engineering
- Integration of nano-scale biological systems knowledge into engineering education.
- Exposure to digital/additive and 3D printing

Sponsorship

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