Northwestern | CENTER FOR SYNTHETIC BIOLOGY

Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales

Assignment 2: Deconstruct a synthetic biology technology – Part 2

Assessment: Graded (35% of the total Homework grade, 10% of the total Participation grade).

Prompt: In a previous assignment you picked a synthetic biology technology and deconstructed it into the biological functions needed. Now let's revisit this technology and use the scales framework we discussed in class to deconstruct it. In a Word document or PowerPoint, answer the following:

1. What are the biological functions within the molecular, network, cell/cell-free systems, and cellular 'communities' scales needed for this technology?
2. Identify and discuss at least three separate challenges that arise at the interface of these scales.
3. What about the societal scale – are there any ethical or societal challenges that arise when thinking about developing or deploying this technology?

Then, prepare a brief presentation (~3 minutes) and be prepared to present in class (see below for detailed instructions). While we would like you to revisit the technology you analyzed in your previous assignment, you may choose a different technology if you feel strongly about doing so. Note – you must choose different technologies than bacterial nitrogen fixation or PRIME editing since we discussed these in detail in class.

Reflection: Comparing to your previous assignment, what do you now know about deconstructing synthetic biology solutions 'along scales'? How has your thinking changed/developed? Include a brief response in your turned in assignment (~1 paragraph; not in your class presentation). The reflection is not graded, but will go towards your participation grade (2.5%).

Submission: Please turn in your assignment - Word Doc and PowerPoint slide deck - with electronic files at least 1 hour before the beginning of class. The Word Document assignment should cover each of the five scales, the three challenges, and your reflection. You can use text and images in a documents, and make sure to include appropriate literature citations to back up your findings. Organize your answers to the prompt in sections – i.e. one section for each of the five scales, and one section for each of the three challenges you identify.

PowerPoint Slide Deck: For your class presentation, you will have **3 minutes** to highlight your analysis with 2 PowerPoint slides: one introductory slide on what your technology is, and one slide detailing two scales you found to be important and the interface challenges between them. You do not need to present your reflection.

Homework Grade Rubric (24 points maximum): Students will be assessed on their turned in assignment on clearly identifying and explaining biological functions within the molecular, network, cell/cell-free systems, and cellular communities scales, and including identifying potential issues at the societal scale; and three separate challenges that arise at the interfaces between three sets of scales. More points are given for more details – i.e. explaining why a

particular function is needed for the technology, how these functions combine together within the technology, why an interface between two scales presents a particular challenge for this technology, and using details and literature citations to support your reasoning.

Scales	**(0 pts)** **Missing** *Criterion is missing*	**(1 pt)** **Beginning** *Little or no evidence of outcome*	**(2pts)** **Developing** *Beginning of/some evidence of outcome*	**(3 pts)** **Accomplished** *Detailed and consistent evidence of outcome*
Evidence of identifying a biological function at the **molecular scale** important for that application.	Scale is **not** mentioned	• Scale is mentioned • Biological function is not clearly articulated • No explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Some explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Detailed explanation of why the function is needed • Scale and function are supported with appropriate evidence from literature (i.e. specific molecule/cell strain name with literature reference)
Evidence of identifying a biological function at the **network** scale important for that application.	Scale is **not** mentioned	• Scale is mentioned • Biological function is not clearly articulated • No explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Some explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Detailed explanation of why the function is needed • Scale and function are supported with appropriate evidence from literature (i.e. specific molecule/cell strain name with literature reference)
Evidence of identifying a biological function at the **cell/cell-free system** scale important for that application.	Scale is **not** mentioned	• Scale is mentioned • Biological function is not clearly articulated • No explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Some explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Detailed explanation of why the function is needed • Scale and function are supported with appropriate evidence from literature (i.e. specific molecule/cell strain name with literature reference)
Evidence of identifying a biological function at the cellular **communities** scale important for that application.	Scale is **not** mentioned	• Scale is mentioned • Biological function is not clearly articulated • No explanation of why the	• Scale is mentioned • Biological function is clearly articulated • Some explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Detailed explanation of why the function is needed • Scale and function are supported with appropriate evidence

		function is needed • Scale and function are not supported with appropriate evidence from literature		from literature (i.e. specific molecule/cell strain name with literature reference)
Evidence of identifying a challenge at the **societal** scale important for that application.	Scale is **not** mentioned	• Scale is mentioned • Biological function is not clearly articulated • No explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Some explanation of why the function is needed • Scale and function are not supported with appropriate evidence from literature	• Scale is mentioned • Biological function is clearly articulated • Detailed explanation of why the function is needed • Scale and function are supported with appropriate evidence from literature (i.e. specific molecule/cell strain name with literature reference)

Challenges	**(0 pts)** **Missing** *Criterion is missing*	**(1 pt)** **Beginning** *Little or no evidence of outcome*	**(2pts)** **Developing** *Beginning of/some evidence of outcome*	**(3 pts)** **Accomplished** *Detailed and consistent evidence of outcome*
Evidence of identifying the **first** challenge between two or more scales.	Interface and challenge are **not** mentioned	• Interface is mentioned • Challenge is not clearly articulated	• Interface is mentioned • Challenge is clearly articulated • Interface and challenge are not supported with appropriate evidence from literature	• Interface is mentioned • Challenge is clearly articulated • Interface and challenge are supported with appropriate evidence from literature
Evidence of identifying the **second** challenge between two or more scales.	Interface and challenge are **not** mentioned	• Interface is mentioned • Challenge is not clearly articulated	• Interface is mentioned • Challenge is clearly articulated • Interface and challenge are not supported with appropriate evidence from literature	• Interface is mentioned • Challenge is clearly articulated • Interface and challenge are supported with appropriate evidence from literature
Evidence of identifying the **third** challenge between two or more scales.	Interface and challenge are **not** mentioned	• Interface is mentioned • Challenge is not clearly articulated	• Interface is mentioned • Challenge is clearly articulated • Interface and challenge are not supported with appropriate evidence from literature	• Interface is mentioned • Challenge is clearly articulated • Interface and challenge are supported with appropriate evidence from literature

Presentation Grade Rubric: Everyone is expected to present. Full credit (7.5%) given for presenting in class, no credit (0%) given for not presenting.

Instructor Notes (not distributed): When introducing this assignment, emphasize that it builds off of Assignment 1, but to now use the scales framework discussed in class to revisit your thinking.

Evaluation Process:

1. TA and instructor will compare a few samples of student work, deciding on ratings. After they have reached agreement, they will score the rest of the student work separately.
2. TA and instructor will compare ratings and discuss any points of disagreement.
3. TA and instructor will record all rubric scores in spreadsheet.
4. Internal evaluator will put into master spreadsheet to examine points of change between assignment 1 responses and assignment 2 responses.