

Introduction

Hydrogen Evolution

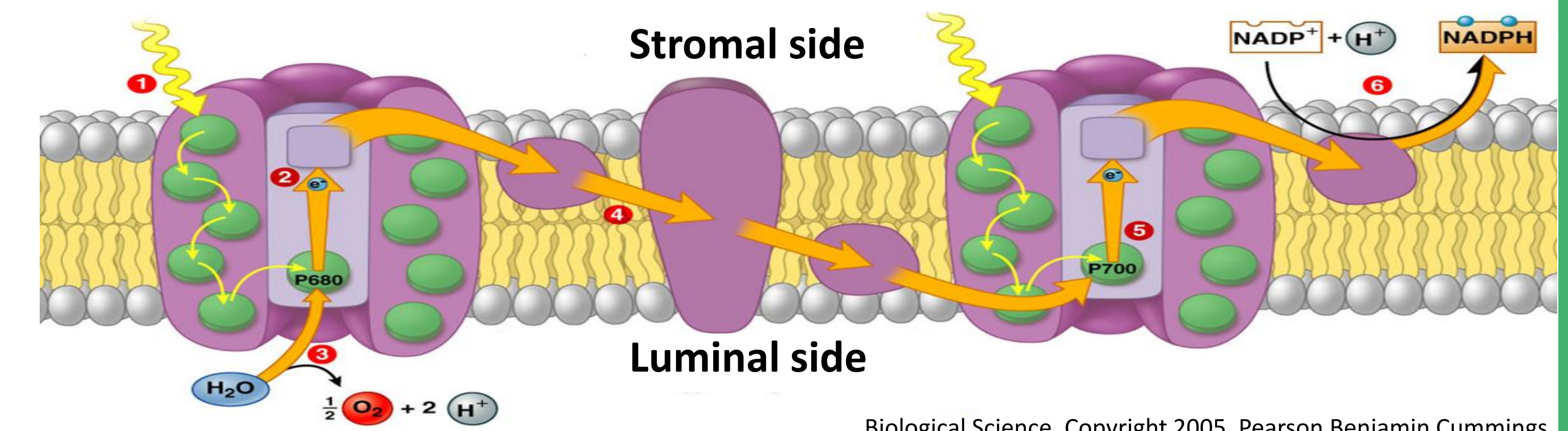
Hydrogen is a strong contender as a next generation clean and green fuel. What if photosynthesis became our hydrogen source?

Role of Photosystems I and II

Photosystem I (PSI) and Photosystem II (PSII) carry out photosynthesis in green plants. PSI has hydrogen reduction abilities, and PSII has water splitting power.

PSI and PSII Assembly

We will integrate these two proteins into a single “wired” assembly for simultaneous water splitting and H₂ generation.

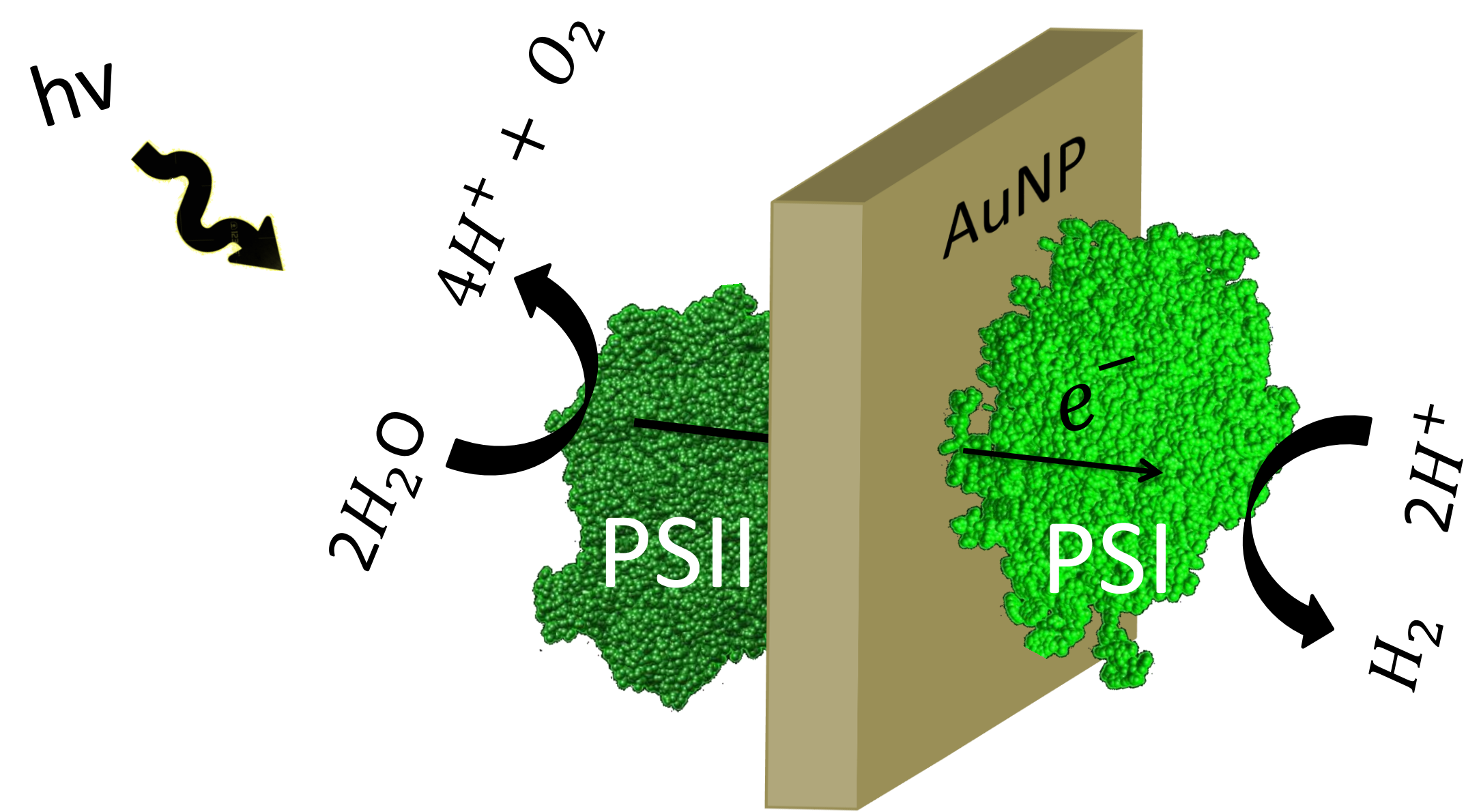


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Objectives

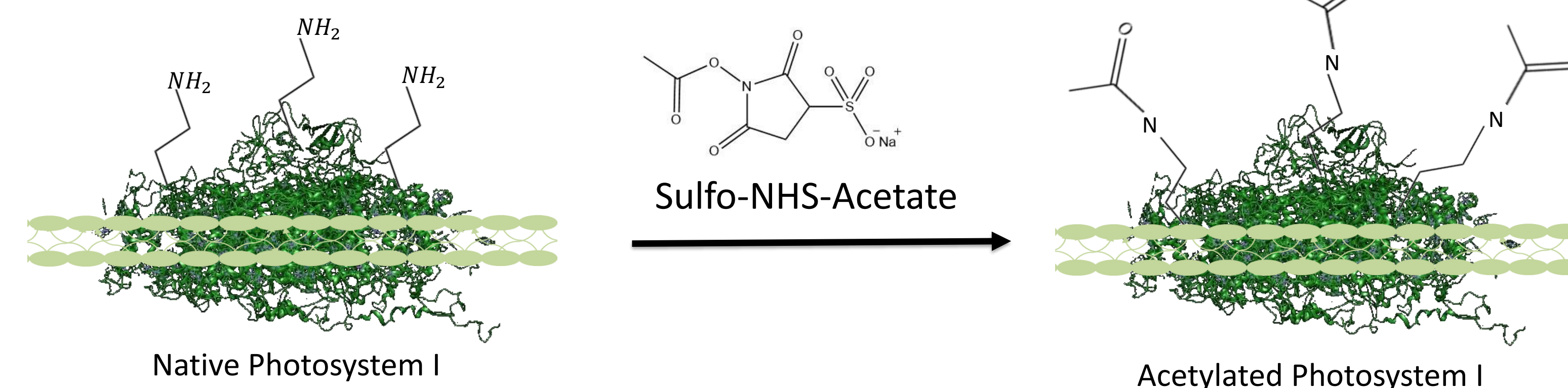
Interface PSI and PSII together in a head-to-tail fashion to sustainably generate H₂ and O₂ from sunlight and water:

- Functionalize PSI with biotin on the luminal-side
- Functionalize PSII with biotin on the stromal-side
- Co-assemble on gold nanoparticle

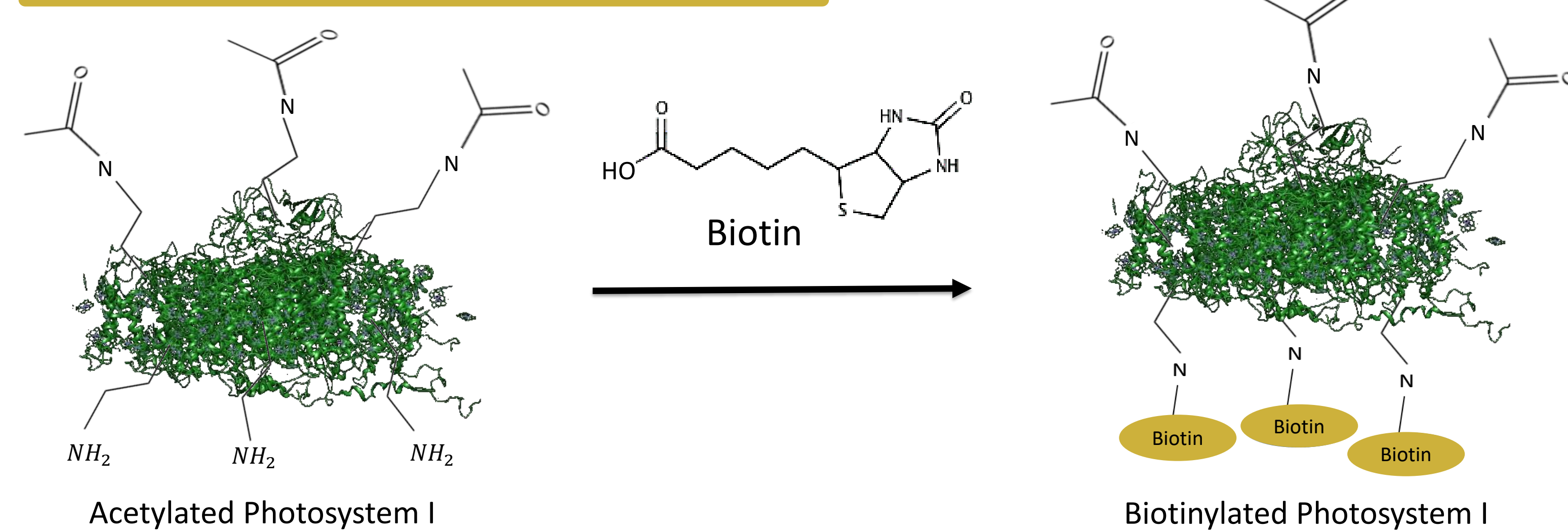


Methodology

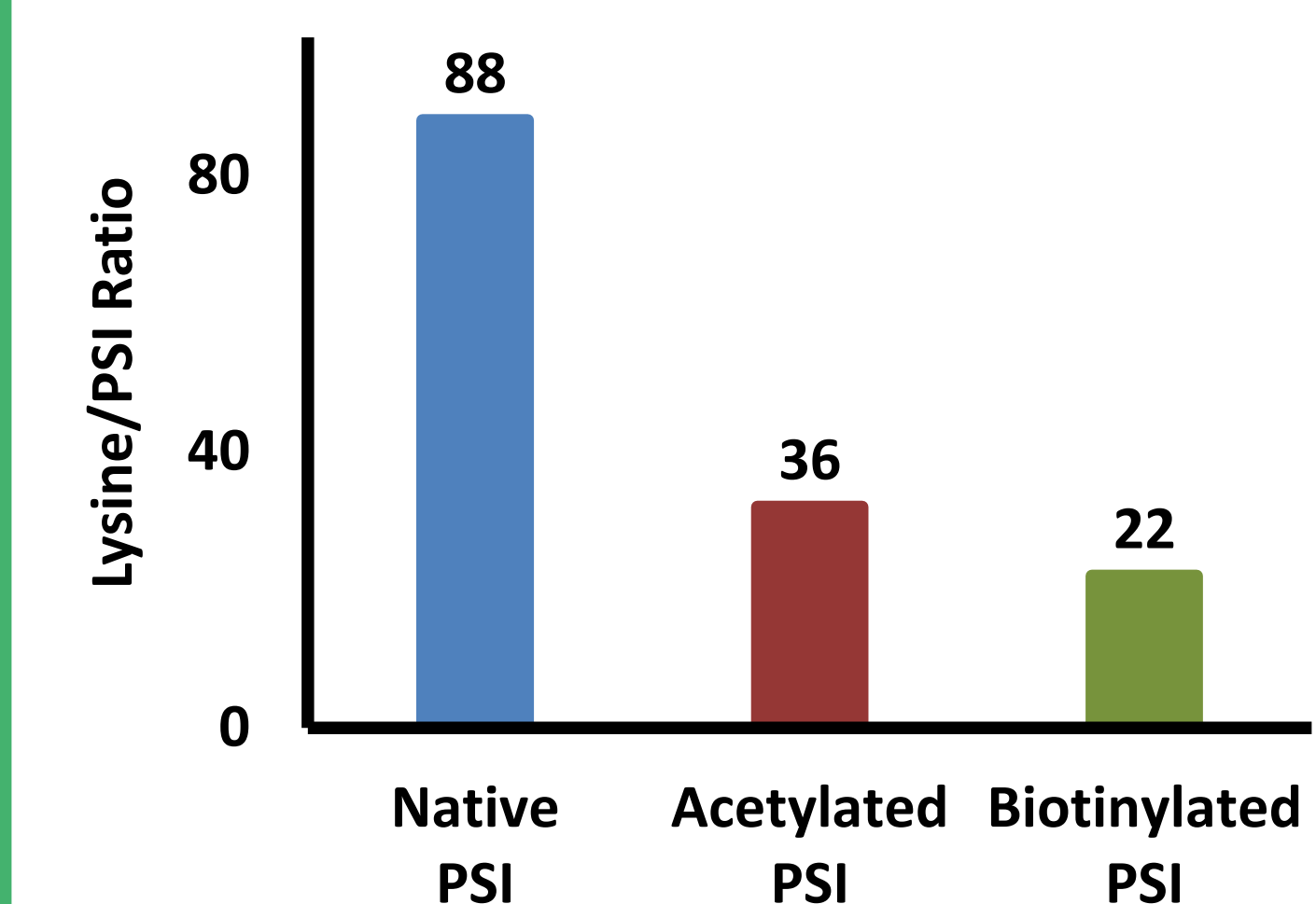
Stromal-side Passivation of PSI



Luminal-side Biotinylation of PSI



Conclusions



PSI has been functionalized on its luminal side, allowing for oriented deposition on streptavidin functionalized gold nanoparticles.

Future Directions

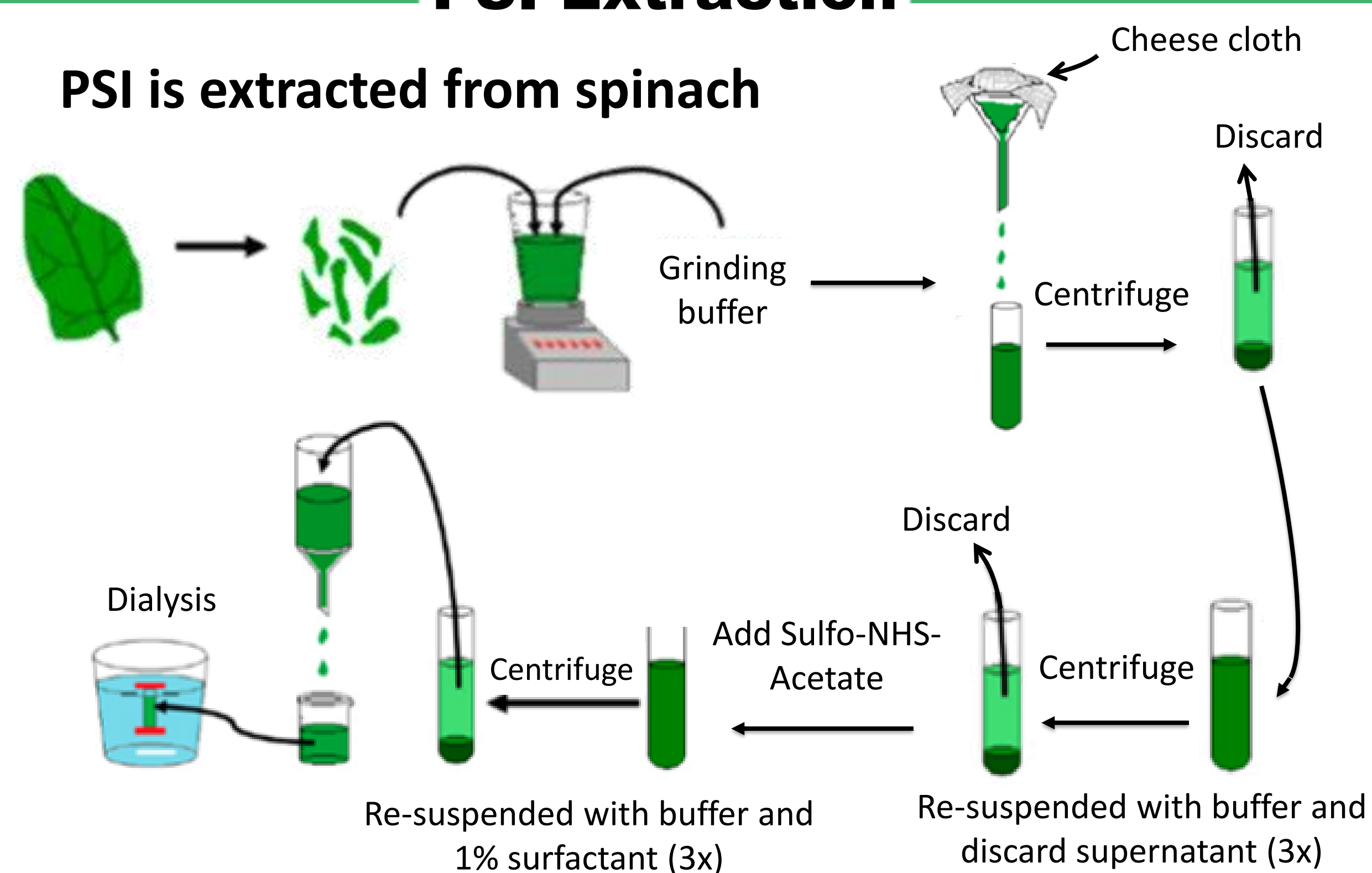
- Optimize biotinylation reaction conditions
- Functionalize PSII with biotin on the stromal-side
- Co-assemble the biotinylated PSI and PSII onto streptavidin-coated gold particles
- Perform oxygen and hydrogen evolution assays for PSI/PSII-AuNP conjugates

References

- [1] Ciesielski, P. N., Cliffl, D. E., & Jennings, G. K. (2011). Kinetic model of the photocatalytic effect of a photosystem I monolayer on a planar electrode surface. *Journal of Physical Chemistry A*, 115(15), 3326–3334.
- [2] Utschig, L. M., Silver, S. C., Mulfort, K. L., & Tiede, D. M. (2011). Nature-Driven Photochemistry for Catalytic Solar Hydrogen, 16334–16337.
- [3] LeBlanc, G., Gizzie, E., Yang, S., Cliffl, D. E., & Jennings, G. K. (2014). Photosystem I protein films at electrode surfaces for solar energy conversion. *Langmuir*, 30(37), 10990–1001. <http://doi.org/10.1021/la500129q>

PSI Extraction

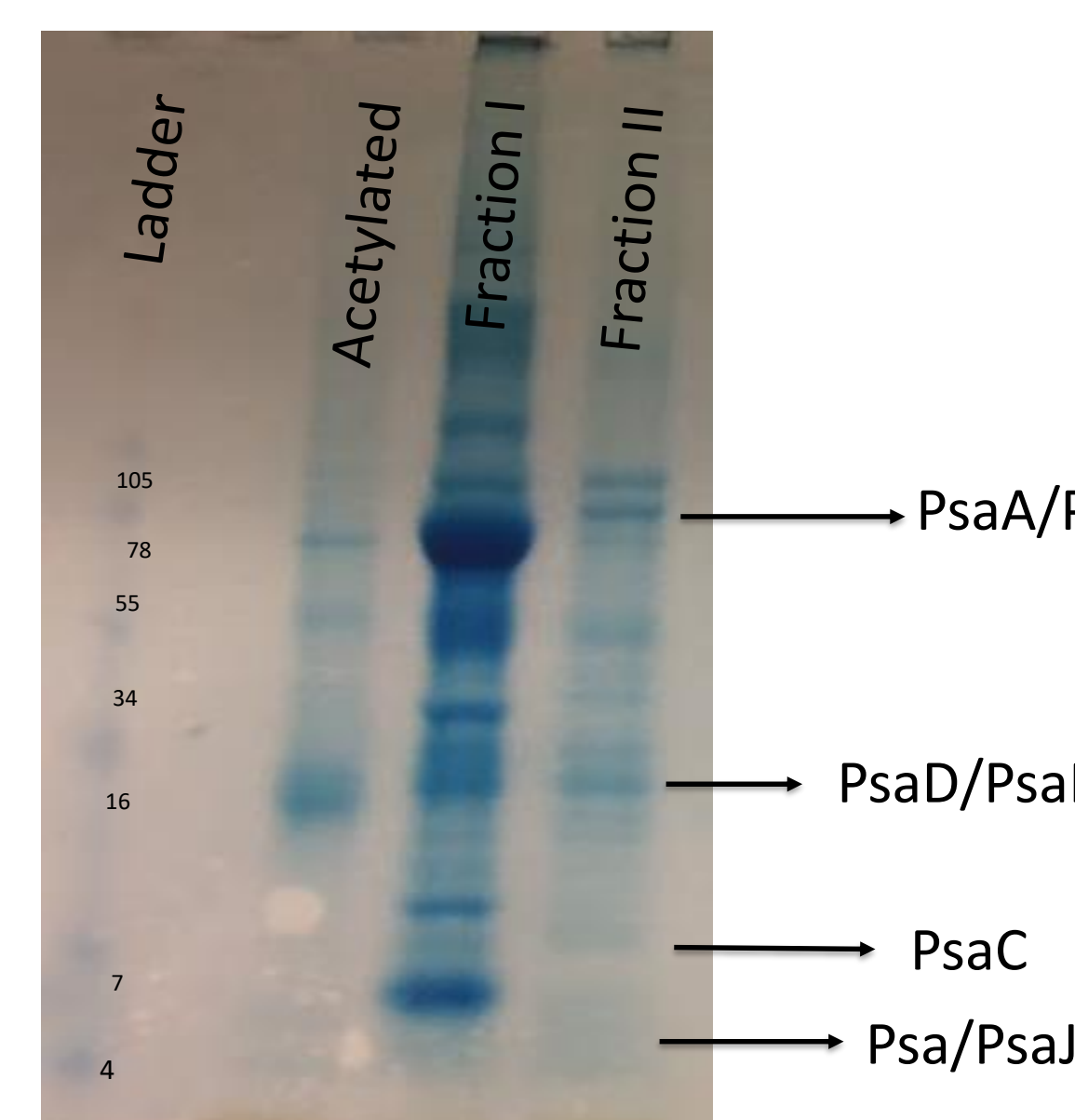
PSI is extracted from spinach



[3] LeBlanc, *Langmuir*, 30(37), 10990–1001.

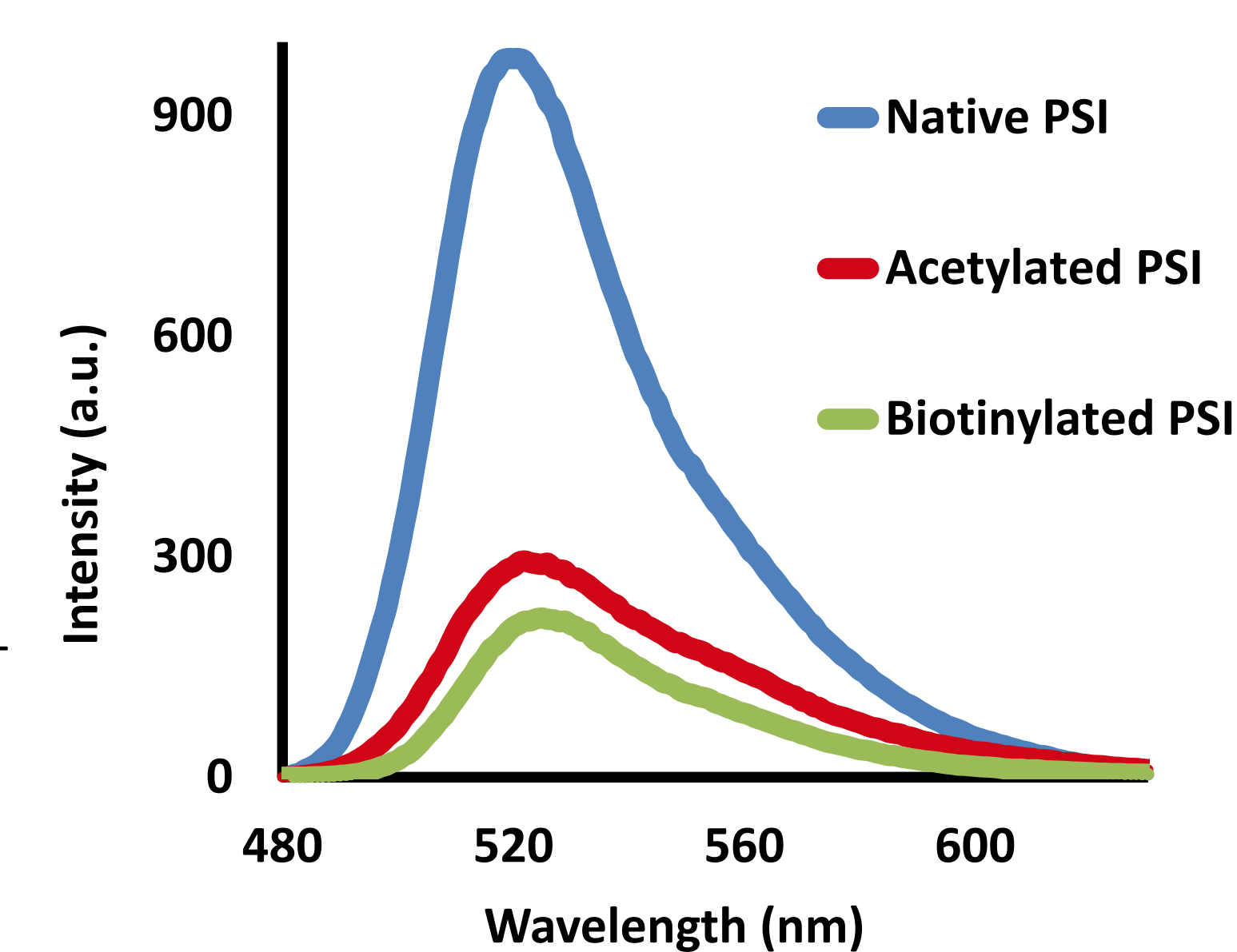
Results

SDS-PAGE Analysis



Biotinylation of Photosystem I was determined spectrophotometrically using Fluorescein Isothiocyanate (FITC), which reacts with primary amines.

Fluorescein Spectroscopy



Acknowledgements

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VINSE

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