

Making Things Glow

Students bring color into chem lab

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Kira Rasmussen '17 and Jacqueline Sullivan '17 are waiting for the chemical mixture they've just heated to 105 degrees to cool. Their test tubes are snug in ice baths to speed the process. Rasmussen, an animal science/pre-vet major, and Sullivan, a zoology and Spanish double major, are two of about two dozen undergraduates measuring and mixing and purifying their way through an organic chemistry lab in Parsons Hall on a recent afternoon.

"They're creating a chemiluminescent reaction," says Peter Frank, a chemistry Ph.D. candidate and one of two teaching assistants in this lab. "Basically they're using chemistry to create light, similar to what fireflies do" when they light up during bioluminescence.

The experiment is designed to teach the class of mostly sophomores about nucleophilic substitution reactions and the relationship between fluorescein structure and the color of light produced.



Once their test tubes have cooled to room temperature, they'll filter the contents, draining the liquid and leaving behind the crystals, which they'll recrystallize to further purify. Later, they'll add more chemicals that, if all goes well, will bring about a spectacular fluorescent light show under their lab hoods.

Basically, they're experimenting with the chemistry behind glow sticks — the fluorescent wands and bobbles you see at concerts — says graduate student Hao Geng, the other teaching assistant in the lab.

Professor Thomas Harris says the experiment has a lot of good chemistry. "We can talk about things like color ... and excited states. We can relate it to why you get light out of a fluorescent or incandescent bulb. From this one experiment we can talk about a lot of things.

"Plus, it's a lot of fun," Harris says.

In fact, "fun" is one of the goals of this experiment, which brings the concepts covered during the course of the semester into a colorful culmination.

Every scientist knows the reality of lab work is that things don't always go as planned.

[UNH Organic Chemistry Lab]

Back under her hood, Rasmussen is filtering, but the contents of her test tube are darker than expected. She thinks it's probably due to impurities in the equipment. Whether that will affect her outcome remains to be seen.

Biomedical major Alex Ura '16 is dumping a test tube full of red liquid because it wasn't as bright as it should have been. "I think the water to suspension was not mixed well enough and came out of suspension," Ura says. "I had to put extra fluorescers into the red one. The heat is supposed to make it more intense but it didn't." He starts over with some pre-prepared mix.

Under another hood, Talia Tarbox '17 and Alison Durkin '17 add a hydrogen peroxide suspension to each of their eight test tubes and watch as things start to glow. Blue, yellow, purple, orange. They take only a few moments to admire the colors before they begin jotting down notes about the hue, intensity and duration of the reaction.

Across the lab, eight more test tubes begin to light up. Someone holds up a smartphone to capture the glow. Harris notes that devices typically aren't allowed in the lab, "But for this experiment we make an exception."

Meanwhile, Rasmussen has run into another challenge – during recrystallization, the contents of one of her test tubes burned. "I think the impurities reacted with the mix, which was still wet, and created a mini-reaction." She begins again with the pre-mixed solution.

"Lab work makes you think, because you have to know what's going on in the reaction," says Sullivan.

Eventually both she and Rasmussen show off glowing test tubes.

"I have a better understanding of cyalume synthesis and chemiluminescence," Sullivan said after class. "It's always rewarding to see the final product after putting time and effort into the procedure. I was thrilled to see my test tubes finally glowing with bright colors."

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