



Nadine Abraham (middle), with parents, Dr. John Abraham and Dr. Sheila Abraham of Twin Lakes, Ohio.

Nadine Abraham earns Achievement in Science for her work with Dr. Palffy-Muhoray

Congratulations to Nadine Abraham, a Western Reserve Academy (Hudson, Ohio) high school senior, who was recognized for an Achievement in Science at the Academy's Fall Awards Program: "Celebration of Student Excellence," on December 3, 2003. Nadine spent this past year working with Dr. Peter Palffy-Muhoray, Professor of Chemical Physics and Associate Director of the Liquid Crystal Institute (LCI) at Kent State University.

Discovering the LCI

She found out about the LCI through the outreach programs at the former Center for (ALCOM), Advanced Liquid Crystalline Optical Materials and began working with Dr. Palffy-Muhoray in January 2003.

"Our active outreach programs allow high school students to learn about Kent State, the Liquid Crystal Institute and how liquid crystals function," Palffy-Muhoray said. "Nadine came to the Liquid Crystal Institute through one such school visit. She is super-creative, dedicated and bright. She and I have a good time, and I pay her as much as she would earn working a part-time job."

Advancing Dippy Duck

While working at the Institute, Abraham applied previously unused sources of energy to a device called a "dunking bird." The dunking bird is a heat engine and is in the same class as the automobile engine. They created Dippy Duck II, a device much like a dunking bird, which runs on stored energy but is not a heat engine.

A familiar example of a heat engine which converts heat to mechanical energy is the automobile engine. Although, heat engines are very common, they are often not very efficient in converting heat energy into work. In particular, if the temperature differences are small, as in the case of the Dippy Duck, the efficiency is very low.

“The purpose of our research was to create an engine which uses the energy stored in un-evaporated water, but which is NOT a heat engine – and which may therefore be more efficient,” Abraham said. “So, we devised Dippy Duck II, which is not a heat engine, but directly taps the chemical potential energy of water. And, in contrast to the original Dippy Duck’s very intricate design, our bird was intended to be constructed with common materials and easily replicable.”

“Our success with Dippy Duck II shows that we were able to harness the energy in water using a reasonably simple design. It also demonstrated to us that energy is stored in commonly available resources. And if improvements in our design to increase efficiency could be made, this engine might hold future possibilities,” she said.

Abraham said her research is relevant because it may allow others to eventually apply alternate sources of energy to everyday mechanical devices.

“I never knew, nor understood, the energy contained in even a single drop of water. This project opened my mind to new possibilities.”

Reflecting on her experience

Her experience in this research ranged from moments of extreme joy to abject frustration. Joy, when their experimental stages worked as they had expected, and frustration while they watched their many motionless initial models stuck in pools of water, powerless to alter the course of their experiment in progress.

“But our weeks of trial and error paid off when we perfected Dippy Duck II to provide publishable results,” Abraham said. “The most important lesson I have realized perhaps, is that I -- and we all -- should always investigate and remain curious about the world around us, and no toy, however silly looking should ever be dismissed.”

Both Dr. Palffy-Muhoray and Abraham spent a considerable amount of time on this project. Due to her schedule (at Reserve, she attends school six days a week, including Saturdays), they met on Sundays, during her three-week long spring break and during June. The project ended in early July 2003; however, they are continuing their research through an interactive web site concerning the Dippy Duck, <http://www.dunkingbird.org/>.

“It was an amazing experience to have the opportunity to work with Dr. Palffy-Muhoray. Through our interaction he exposed me to new and exciting areas in the fields of science and math, and guided me through our research. His enthusiasm for learning and discovery also sparked my curiosity and encouraged me to explore my surroundings.”

“I am certainly interested in the fields of science and math, and would like to continue with this project into the future. Specifically, I would like to improve the efficiency of our engine, and research its future possibilities.”

Not your average High School Senior

Abraham is currently involved in many activities at Western Reserve Academy including: Co-editor-in-chief of the school newspaper, *The Reserve Record*, a member of Reserve’s JETS team (Junior

Engineering Technical Society), a member of Reserve's Investment Club, and a member of the French club. She plays varsity tennis and participates on the kickboxing and lacrosse teams.

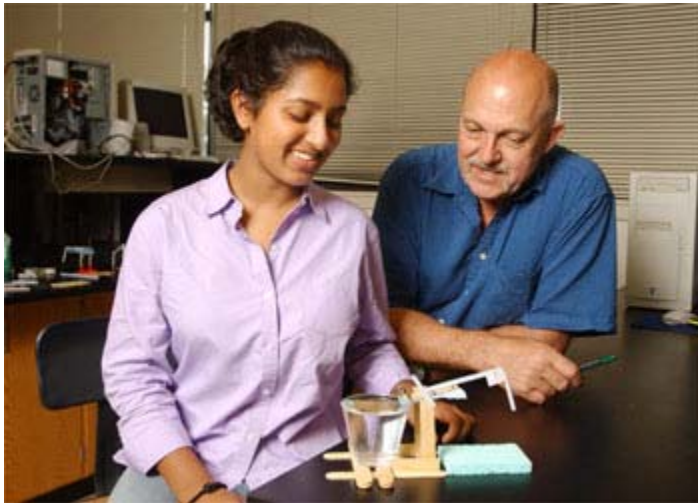
During the awards assembly she was also inducted into the National Cum Laude Society, which is Western Reserve Academy's highest academic recognition. And, she was also recognized as a commended scholar for the PSAT, which is the National Merit Scholarship exam.

Abraham said she enjoys all aspects of science, particularly physics and chemistry, which led to her interest in working with Dr. Palfy-Muhoray. She plans to attend college and would like to major in mathematics.

Check out the Web site

To find out more about their project go to: <http://www.dunkingbird.org/>

More information about the Duck's design and its mechanical workings will appear in an article in *The American Journal of Physics*.



Nadine Abraham (left), with Dr. Peter Palfy-Muhoray, Professor, Chemical Physics and Associate Director of LCI.