Nov. 1, 2015 – WARNING: You will get wet. The mechanical engineering students who work inside one of Utah State’s newest research centers don’t mind getting the occasional work-related soak. The whole lab is one giant splash zone and the creative workshop of newly-hired assistant professor of mechanical engineering Dr. Tadd Truscott.

Truscott built the first Splash Lab at Brigham Young University before coming to USU. The facility might look like a tinkerer’s paradise, but behind all the toys and tanks is serious business – high tech research with funding from the U.S. Navy and other high profile interest groups.

“The purpose of the lab is improve our understanding of physical phenomena – typically in fluids – through visualization, observation and modeling and then to disseminate the information in a way that inspires people.”

Truscott is an MIT graduate and a top expert in fluid mechanics. In one of his most recent projects, he and his team demonstrated how a spinning sphere in a shallow bath of fluid can act like a pump. The concept is nothing fancy. He boils an egg, spills some milk on the kitchen counter and with a twist of the wrist sends the egg spinning through the puddle. What happens next is a simple principle of fluid dynamics, but it had never been fully explained in the scientific community until Truscott came along.
“As the egg spins through the milk, the fluid is drawn up the sides of the egg and then ejected at a point near the equator,” he explained. “This phenomenon occurs when any partially submerged object whose radius increases upward from beneath the fluid surface spins in a liquid bath.”

An image of the egg and its beautiful radial jets of blue-colored milk was captured with a high-speed camera. The mesmerizing photo along with Truscott’s findings captured the attention of other scientists and media and was featured on the cover of Physics of Fluids earlier this year. Through additional research, Truscott says the concept of the spinning sphere could be used to design and build a more efficient pump capable of moving viscous fluids at high rates.

The egg project is just one of many Splash Lab studies on how objects move through fluids and how a better understanding of fluid mechanics can help engineers develop smarter technology.

“There are so many applications for this type of research,” says Truscott. “The Navy, for example, is interested in how projectiles travel through water, the kind of sounds they make as they enter the water surface and even ways to alter the forces on the surface of impacting bodies like ships. Understanding why splashing occurs can help produce safer laboratories and even more hygienic restrooms. The possibilities seem endless.”
Another exciting development for Truscott involves the unlikely combination of schools of fish and a pack of Tour de France riders. Truscott was recently named a Department of The Navy Young Investigator for his research on how groups of animals (or bicycle riders) move together in synchronization – better known as swarming. Mimicking the patterns and precision displayed in swarming could lead to safer and more efficient use of autonomous vehicles.

“Developing these forms of swarming algorithms from the ground up would be daunting,” said Truscott, “But nature has already figured out how autonomous creatures can move together with striking efficiency in, for example, a shoal of herring or a murmuration of starlings.”

Truscott’s research will focus on how an animal’s individual sensory inputs and movements lead to the behavior of a larger group. A better understanding of swarming behavior has big implications for our modern world.

“Recently, there has been increased interest in using collective groups of autonomous vehicles to perform coordinated surveillance, search and rescue, environmental hazards modeling or coordinated evasion operations,” said Truscott. “Our observation techniques focus on kinematics and sensory cues. From that, we’ll develop models of the animals’ behavior and attempt to mimic them by implementing our models in swarms of small table robots.”

Truscott’s team will use a multi-camera array to capture high resolution images of insects, birds and small fish. This data will then be analyzed and incorporated into 3D models. The effectiveness of the resulting swarm behavior models will be evaluated using virtual simulations and live implementation using a group of tabletop robots.