Even clean surfaces like glass can alter ATP.

"Wherever bacteria interact with solid surfaces, metabolic activity can vary," says Brown, "even on clean surfaces like the glass we use in our lab. We have found that when bacteria adhere to a surface, the cell’s adenosine triphosphate (ATP) level can change dramatically. ATP is the main energy carrier for living organisms, and we want to know how its concentration is affected by the process of adhesion."

Brown hypothesizes that there is a link between ATP formation and the variation in a cell’s surface charge and pH as it approaches another surface. He believes the adhesion process itself, rather than the presence of nutrients or growth substrate at the solid surface, is what affects ATP formation.

"Bacteria don't have eyes or fingertips, so how do they know when they hit a surface?" Brown asks. "I want to understand what triggers that change in ATP. What tells the cells they've hit something? Then perhaps we can utilize ATP to either encourage or inhibit cells from colonizing certain surfaces."

This complex link between physicochemical and bio-energetic processes fascinates Brown. If engineers can tailor the properties of a solid surface, perhaps they can control ATP formation. The right surface coating could deplete cellular ATP and kill bacteria adhering to a water pipeline. Or it could increase cellular ATP and stimulate bacteria to degrade toxic chemicals in polluted water.

Brown also studies the movement of bacteria through soils, which is of interest to scientists tracking the spread of pathogens in groundwater or homebuilders seeking a safe distance from a septic system to a water well.

"People often think of me as a microbiologist, but I'm not. I am an engineer who happens to be studying microbiology," he says, "and I love using math to describe microbiological processes."