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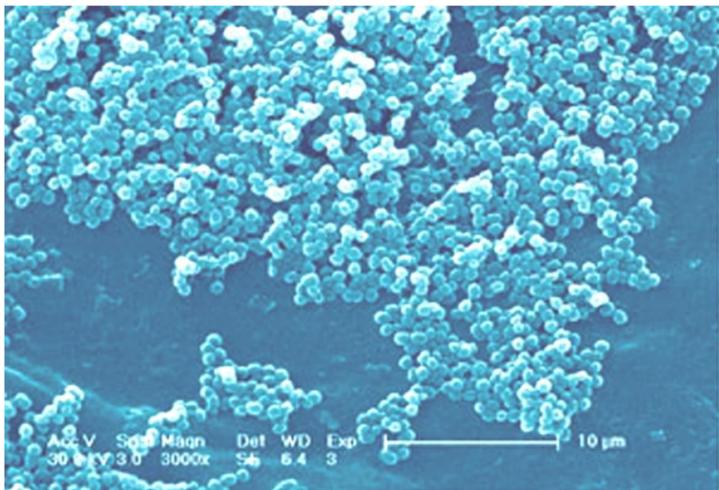
Newton, New Hampshire

Biology

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Growth of Microbial Biofilms

Scientists have been studying bacteria for centuries, often stumbling upon major discoveries. Microbiology is a field that was not well understood for many years due to the sheer size of the organisms being studied. Even today, life-changing discoveries are made on a daily basis. It wasn't until the past several decades that researchers began accepting the idea that not all bacteria live in a unicellular fashion, and that this may actually be unusual behavior for the organisms. Microbes found in their natural habitats are often found living multicellularly in what have been termed biofilms.



Curtin, J.J. and R.M. Donlan. Using bacteriophages to reduce formation of catheter-associated biofilms by *Staphylococcus epidermidis*. *Antimicrob. Agents Chemother.* 50:1268-1275.

Biofilms are generally defined as a group of bacteria held together by an extracellular matrix that is attached to a wet surface. Biofilms can be found in many places including rocks in a stream, the cavities on teeth, in showers, and even in extreme environments such as on glaciers. Recent studies have shown that although performing experiments on pure cultures of bacteria may be useful, it may not be as effective as believed by Robert Koch whose postulates have been the basis for modern microbiology. Through direct observation of bacteria in their natural environment, it is clear that pure cultures are actually quite different from their natural counterparts.

One may ask why this is important when we have pure cultures to test. Biofilms are a huge concern as they have shown, time and time again, to be more antibiotic resistant than their planktonic counterparts. *Pseudomonas aeruginosa* biofilms have shown to be up to 1000x more antibiotic resistant than planktonic cells. In a time of such medical uncertainty and a lack of development of new antibiotics, this is a huge concern for the general public.

Biofilms have been wreaking havoc in hospitals for years, often going undetected until it is too late. Biofilms can be found in the lungs of cystic fibrosis patients, on catheters, and can even grow in surgical wounds; although generally only a problem for immune-compromised patients, this has recently become a problem for generally healthy patients entering hospitals for minor injuries or illnesses.

Biofilms need a surface on which to grow which can be difficult to produce in a laboratory. It has also been shown that biofilm bacteria will only form a biofilm if there is a physiological need to do so. Once a biofilm has been formed, it is also possible for it to disassemble depending on environmental changes. Another problem that must be taken into consideration is that in nature, biofilms are often not pure cultures, but many organisms living in one extracellular matrix. In order to reproduce a true, natural setting for these microbes, researchers have to attempt to make the biofilm as true to natural as possible without adding other organisms.

It was only recently that scientists began attempting to reproduce a natural setting for these biofilms in the laboratory. Many procedures have been produced to study biofilms, but are not always reproducible; it seems, in fact, that many labs use different means of studying these biofilms. Often technology required to perform these experiments is beyond the means of small colleges and even some universities. Also due to the lack of reproducible procedure for growing biofilms, it is harder for small schools to perform these experiments because they do not always produce outcomes.

For my experiment, I would like to perform some of the most commonly used procedures for growing biofilms and modify them in a way that would work best for small schools. Assuming that these procedures work, I would like to then take the best components of said procedures to produce my own. Once this is done, I would again have another student perform this procedure based solely on my written notes to test for reproducibility.

As microbiologists begin to change their view of the organisms which they study, they must also develop their skills to meet the needs of the organism. This change can be hard, especially when medicine has been so effective in the past on organisms that were so misunderstood. It is vitally important that researchers begin developing procedures that can be used in most laboratory settings. To do so, one must understand the current norm as well as the infinite possibilities ahead.