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OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Phrama scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bengaluru and Mumbai.

Antimicrobial Surfaces

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INTRODUCTION/ABSTRACT

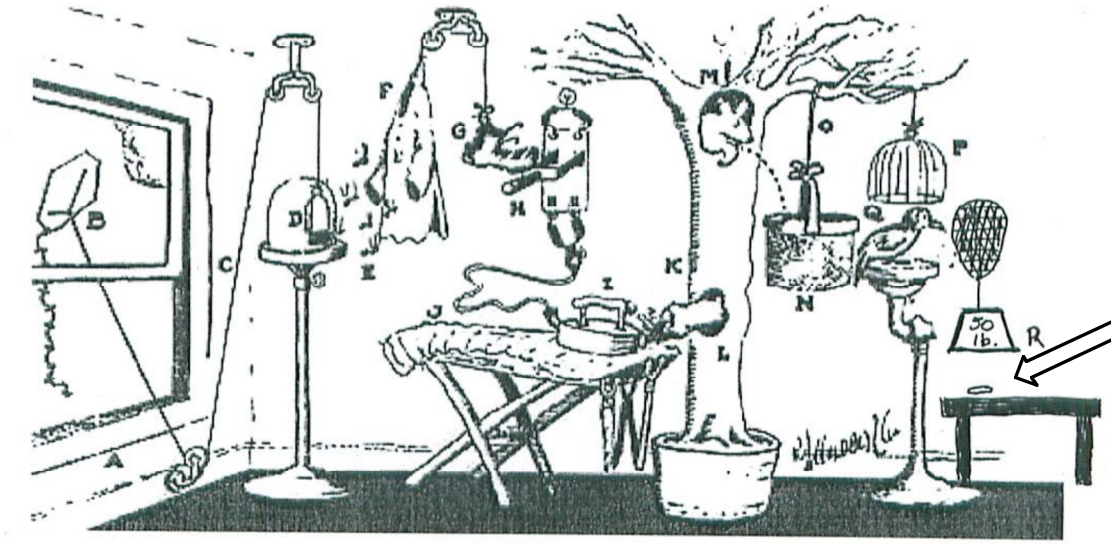
Efforts of our laboratory for some time have been directed toward the development of methods to render a variety of surfaces permanently antimicrobial (antibacterial/antifungal) in a passive manner. We summarize here our efforts in accomplishing this goal. Two general approaches have been developed that allow a broad range of surfaces to be so modified with excellent results. The application of these approaches toward a range of surfaces is discussed, along with the mode of their action, and the observation of the results. Finally, a direct commercial application of the procedure that is currently being explored is discussed.

ANTIBIOTIC SITUATION

The situation with antibiotic resistance development has become critical in modern society. The process of mutation of bacteria advances more rapidly than new, more powerful and broadly acting antibiotics can be developed. This situation has generated a need for: a) the development of antibacterial pharmaceuticals that are not dependent on the attack of metabolic processes, and b) the prevention of bacterial infection, again using approaches that are not using metabolic targets.

The efforts described here relate to the second of these two needs: prophylaxis *via* the killing of bacteria before they can be transmitted from one organism to another or can be taken into a particular organism. All of this must be done using a mode that does not attack metabolic targets by which a bacterium can undergo rapid mutation to develop resistance and preserve its future generations.

Antibiotics as an approach toward antibacterial activity:



bacterium

Generalization of our approach toward antibacterial activity:

"Everything should be made as simple as possible, but not one bit simpler."

A. Einstein

In a classical vein, the assassination of Julius Caesar was a very simple matter - 23 stab wounds, rather than indirect poisoning. This is our approach to killing bacteria.

General concept for antibacterial action of cationic lipids (the chemical knives in this instance):

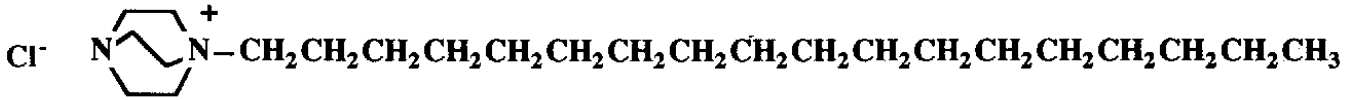
1. Lipophilic invasion of cell wall

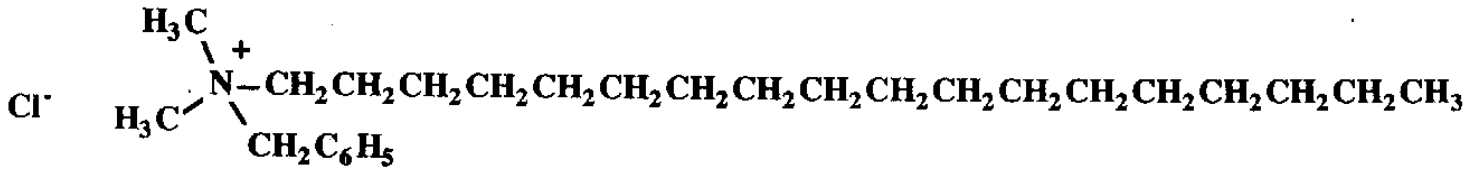
2. Electrostatic disruption of cell wall by charged site on agent

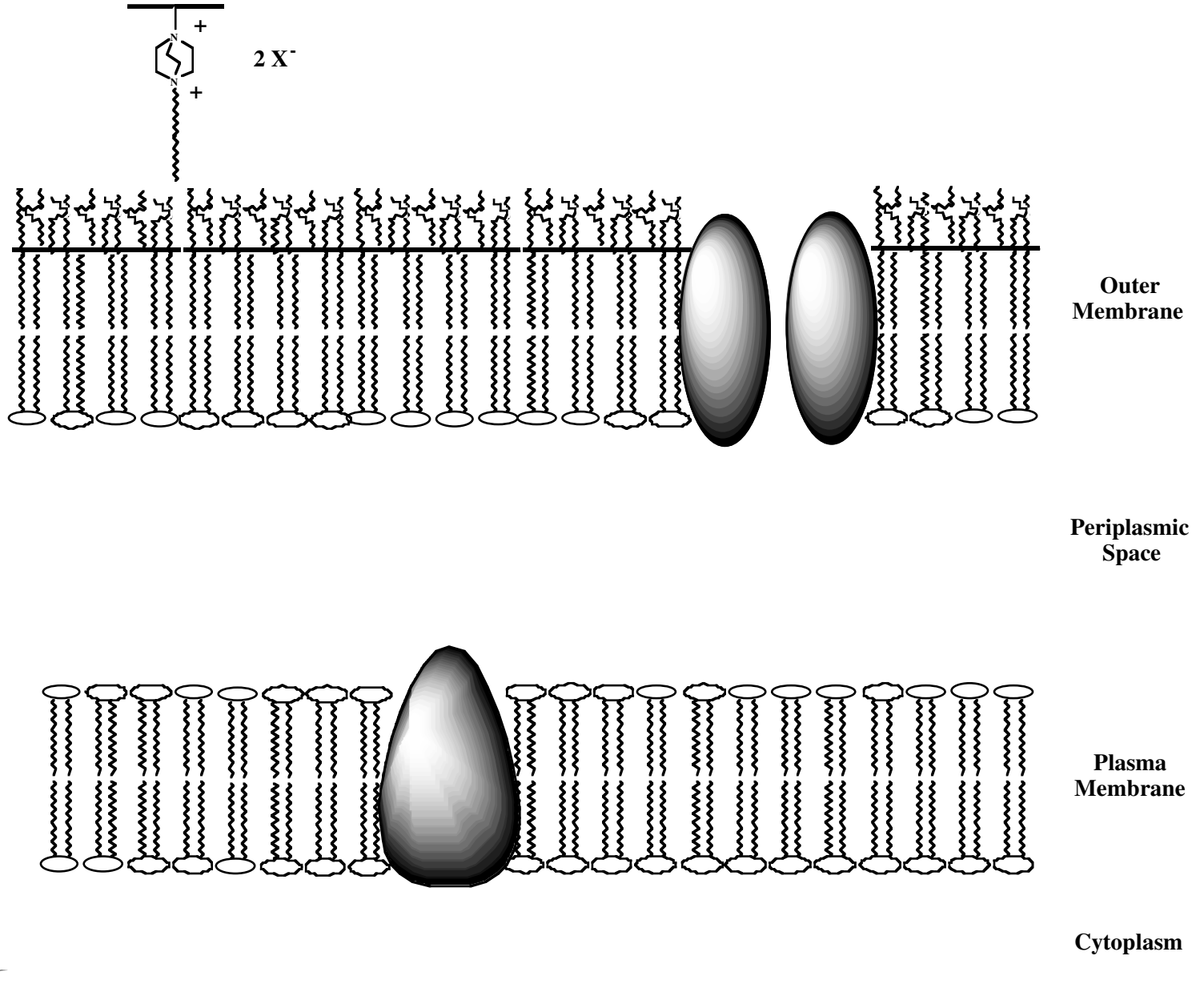
Verification of mode of action using *Staphylococcus aureus* treated with Gram stain.

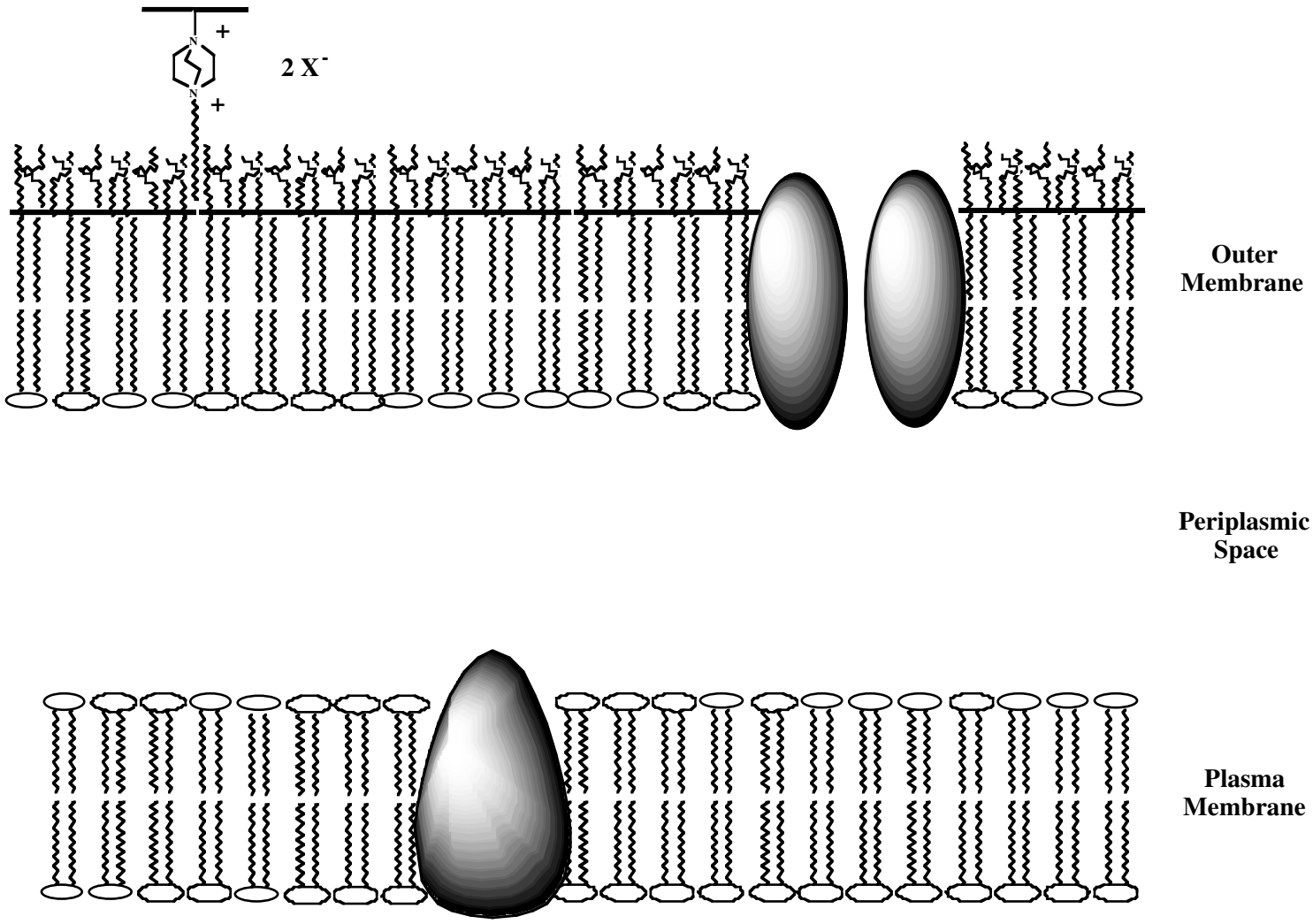
It is well known that cationic lipids act against bacteria by invasion of the cell wall by the neutral lipid portion followed by disruption of the cell wall by electrostatic interaction once the charged site reaches the cell wall.

In our efforts, cationic lipids are directly associated with a surface, generally through the charged end, leaving the neutral lipid portion extending from that surface. Two types of such cationic lipids are shown below






2 X-
Outer Membrane
Periplasmic Space
Plasma Membrane
Cytoplasm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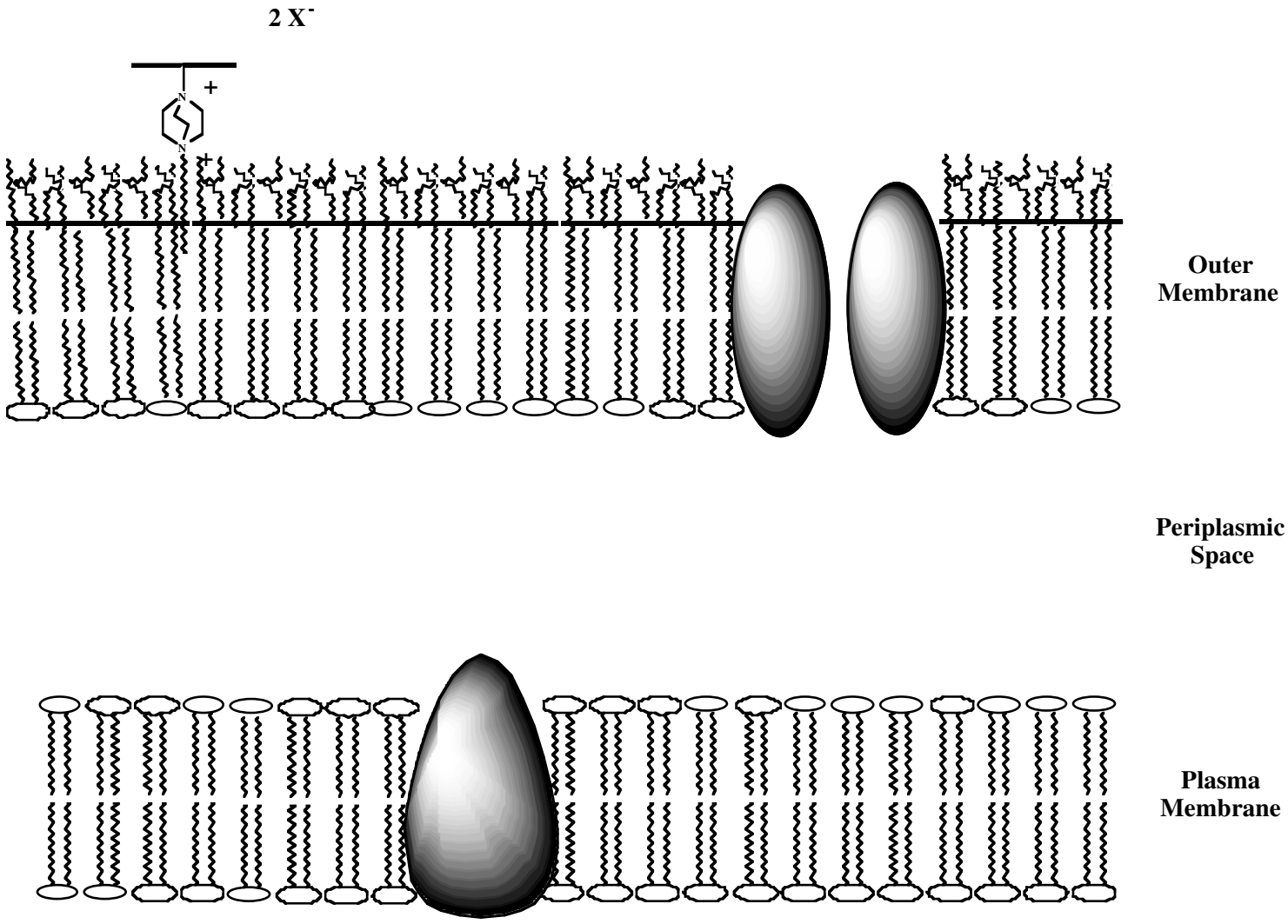
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Plasma Membrane
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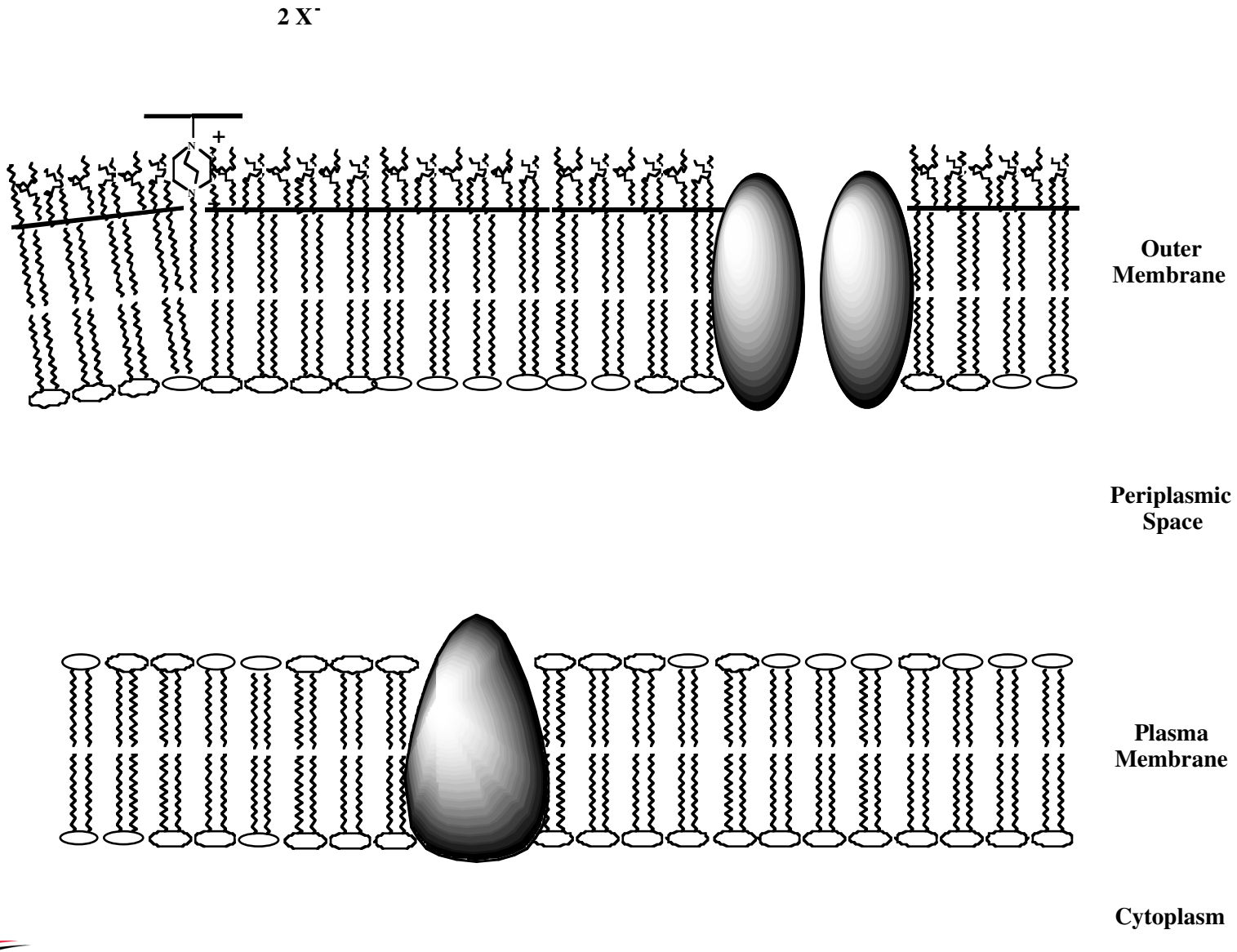
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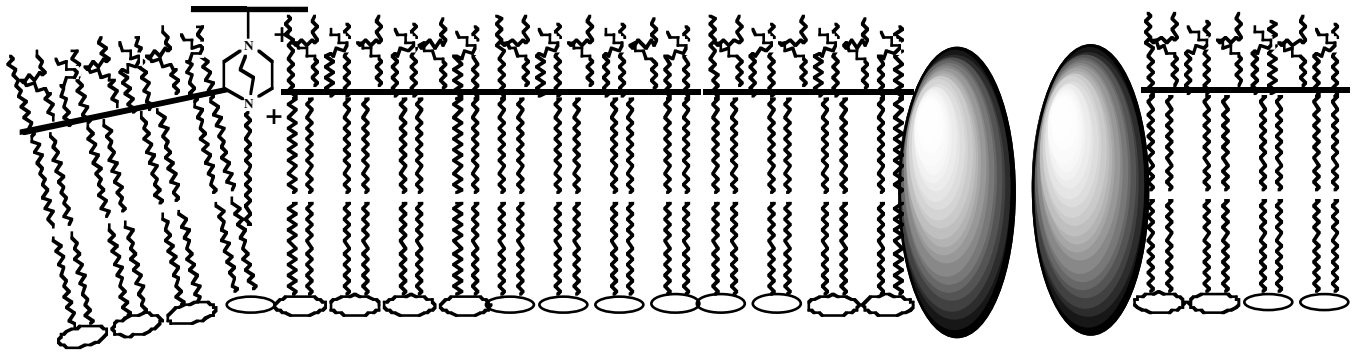
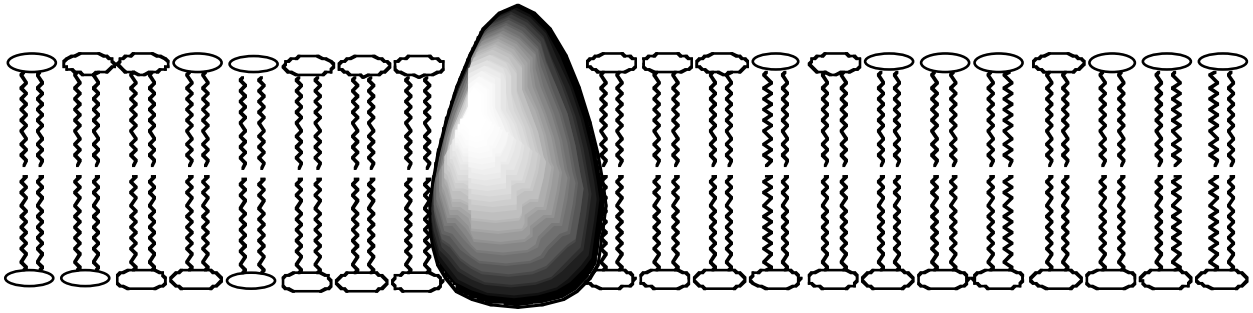
Periplasmic Space
Plasma Membrane
Cytoplasm

$2\ X^-$



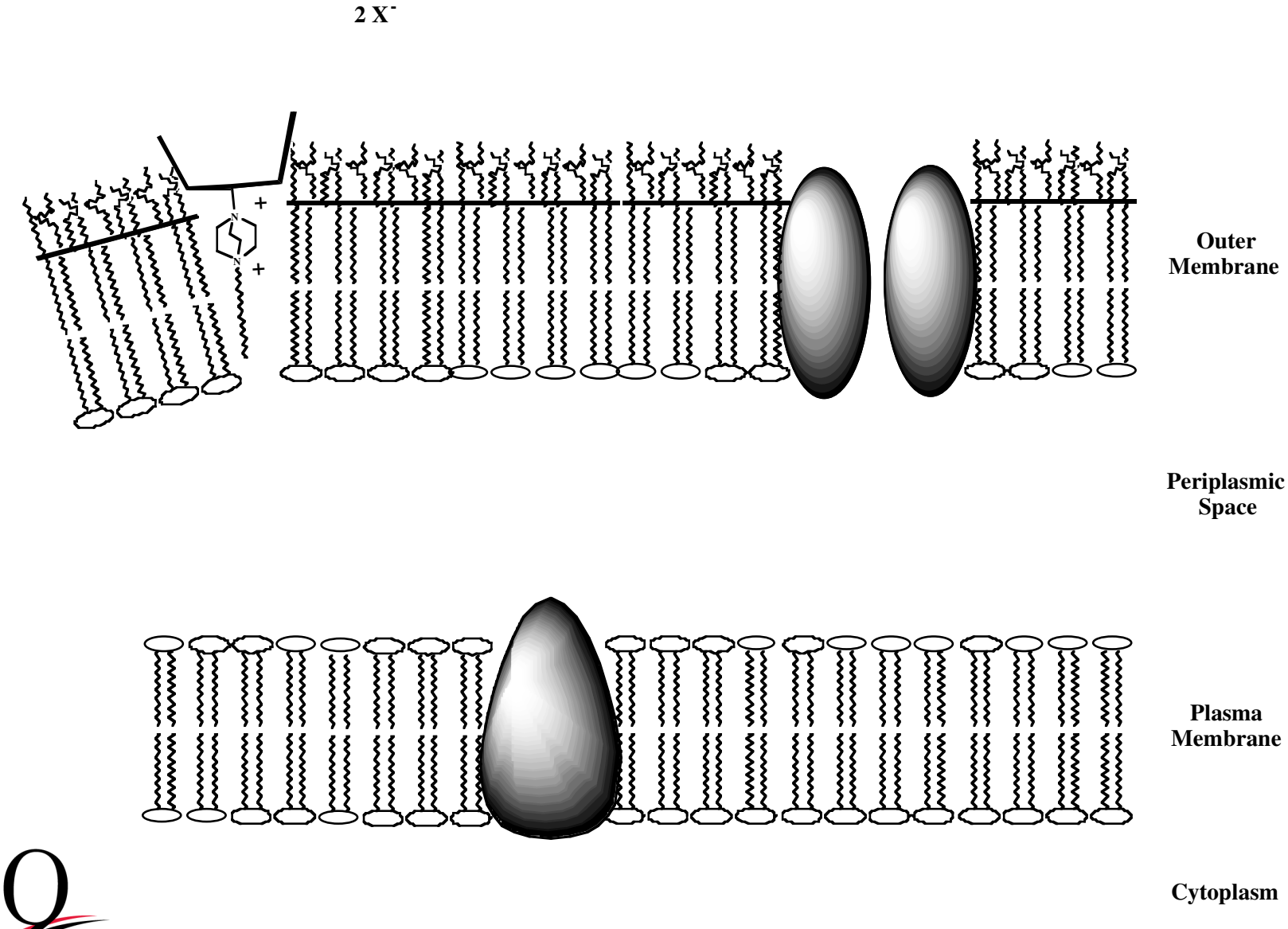
Outer Membrane

Periplasmic Space



Plasma Membrane

Cytoplasm


2 X-
Outer Membrane
Periplasmic Space
Plasma Membrane
Cytoplasm

Surface activity *vs*. solution activity of cationic lipids:

In solution, cationic lipids must impinge in concert (unfavorable ΔS) to provide sufficient piercing of cell wall.

On surface, cationic lipids are already organized (unfavorable ΔS is overcome by prior organization) to provide concerted action against cell wall.

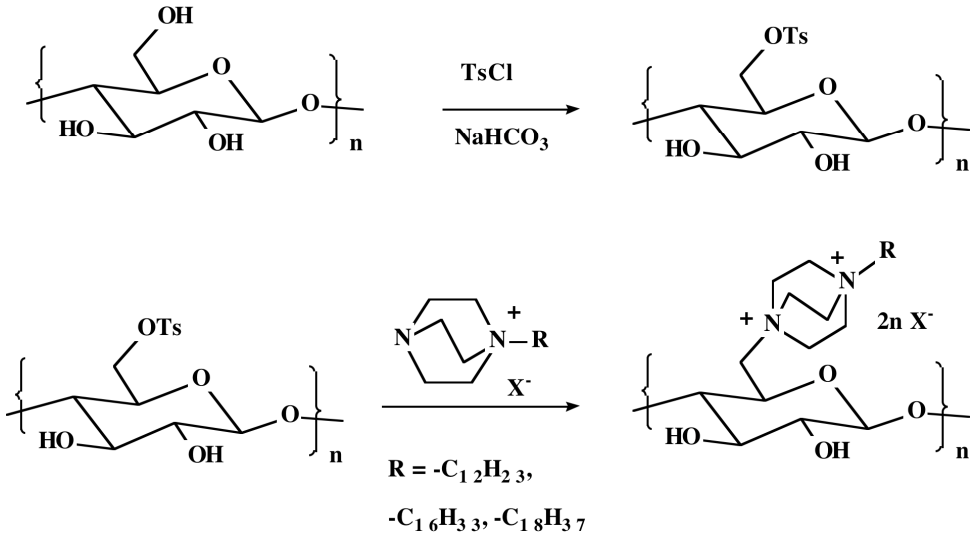
Comparing our method with the cationic lipids as found in antibacterial soaps can be done considering the fellow shown here.

Grabbing a porcupine (not a recommended action) with your hand will cause significant (but temporary) pain to the hand - but it won't kill you. However, falling (naked) onto a porcupine the size of a football field will tear off most of your skin, and be lethal.

This is the essence of our system's action against bacteria and fungi.

Modes of surface incorporation:

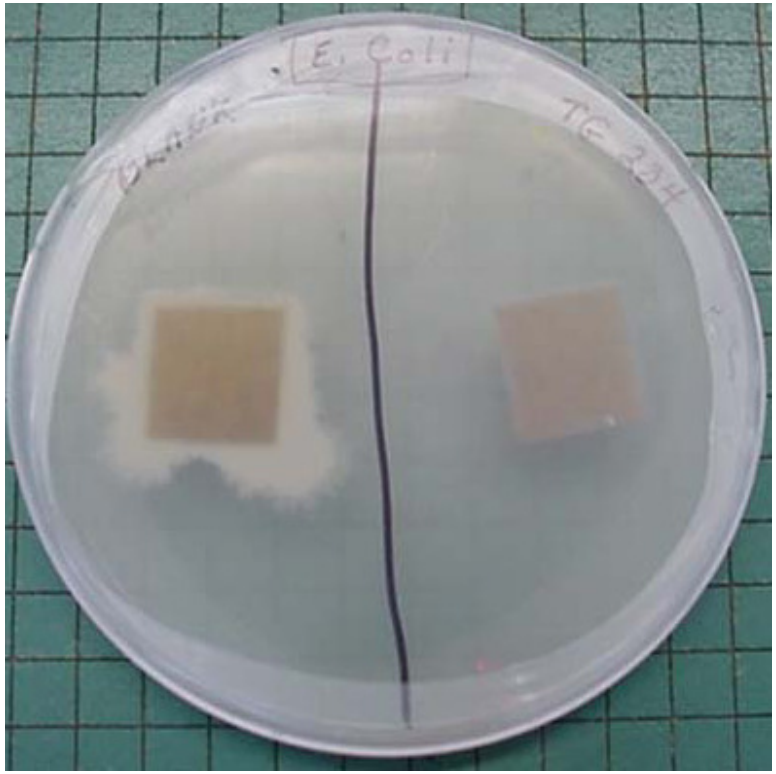
1. Covalent binding by two-step procedure to carbohydrate or proteinaceous surface (cotton, silk, wool, paper, wood).

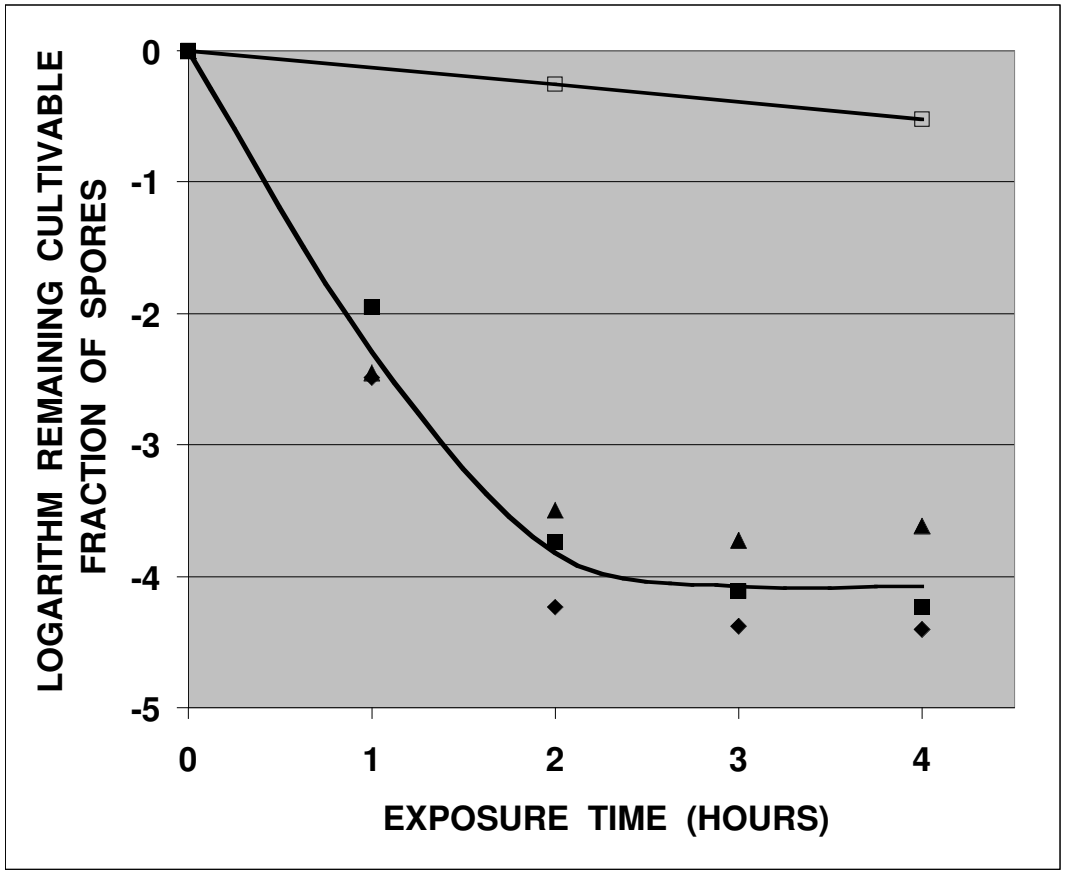


2. Incorporation into surface material by dissolving or coating (polyester, PVC, paint).

Use simple quats, *e.g.*
***N*-hexadecyltrimethylammonium chloride**
among others

Biological Testing Procedure





Blank

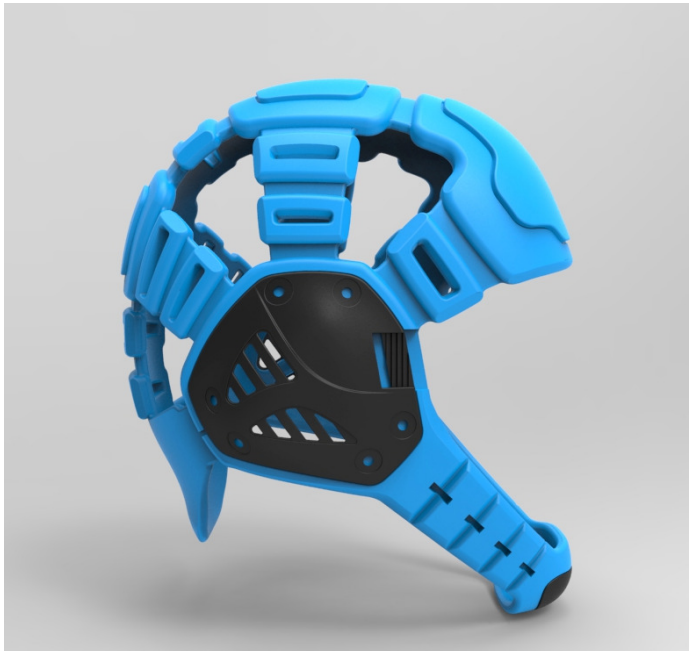
Anthrax spore testing

Staphylococcus aureus **(Gram + bacterium)**
including MRSA
Escherichia coli **(Gram - bacterium)**
Pseudomonas aeruginosa **(Gram - bacterium)**
Bacillus cereus **(Gram + bacterium)**
Aspergillus niger **(fungus)**

Bacillus anthracis **(Gram + bacterium)**
Saccharomyces cerevisciae **(yeast/fungus)**
Candida albicans **(yeast/fungus)**
Klebsiella pneumoniae **(Gram - bacterium)**
Chaetomium globosum **(fungus)**
Streptococcus faecalis **(Gram + bacterium)**
Proteus mirabilis **(Gram - bacterium)**
Burkholderia caepacia **(Gram - bacterium)**
Acinetobacter baumannii **(Gram - bacterium)**

Current Commercial Application

Wrestling (Olympic style) and related martial arts contact sports face a serious difficulty with transmission of bacterial and fungal diseases through the normal bodily contact. Helmets are currently being produced incorporating this technology to prevent the transfer of pathogenic bacteria and fungi, such as with the helmet as shown.



In this application the method of incorporating the cationic lipid into the preformed plastic provides the protection.

This is being produced through the commercial entity

QuatScience™

This technology is applicable to a wide range of surfaces, including, but not limited to: fabric of all types, wood, cork, PVC, polyethylene, polypropylene, polyester, among others.

For copies of patents and further information, contact:

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