



Indus Center for Academic Excellence (ICAE)

Awards Program
Sunday June 8th, 2008

**Using Lasers to Detect and Identify Bacteria:
An Inter-disciplinary Project**

Steve Rehse
Dept. of Physics and Astronomy

Why is this “Interdisciplinary”

Using Lasers Detect and Kill Bacteria

**Interdisciplinary
Science**

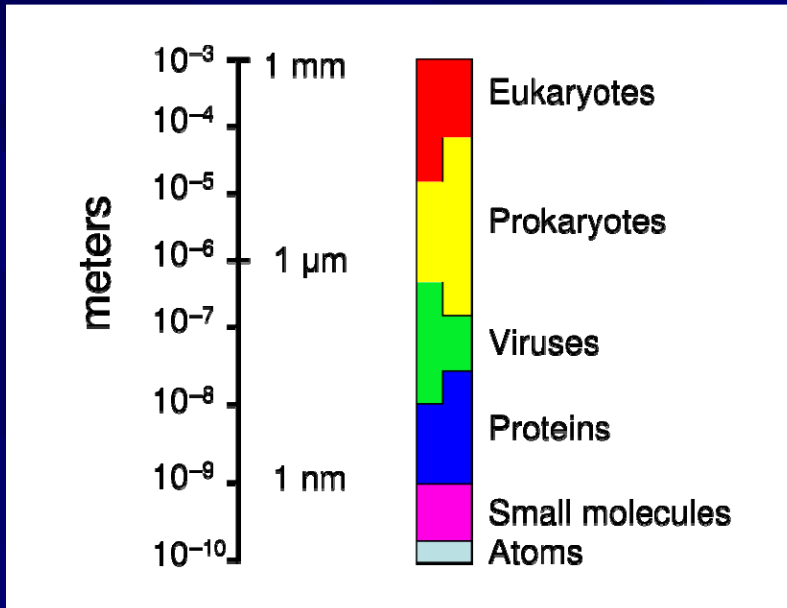
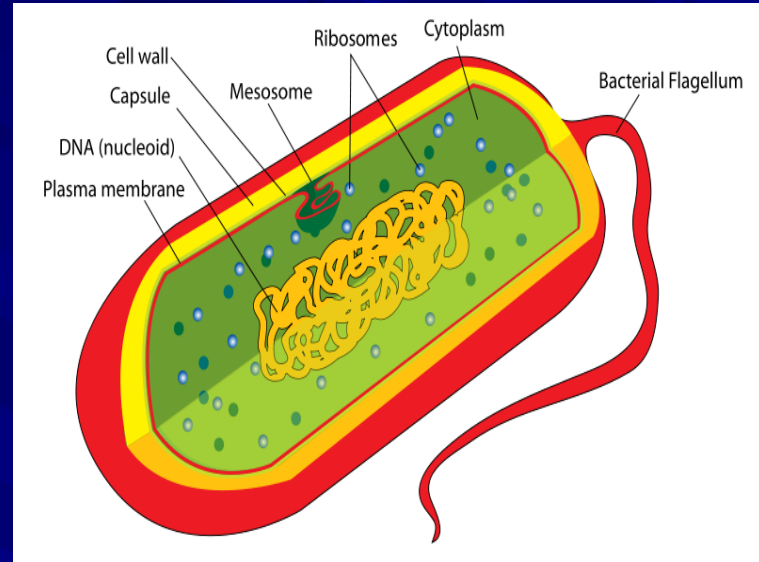
physics

biology

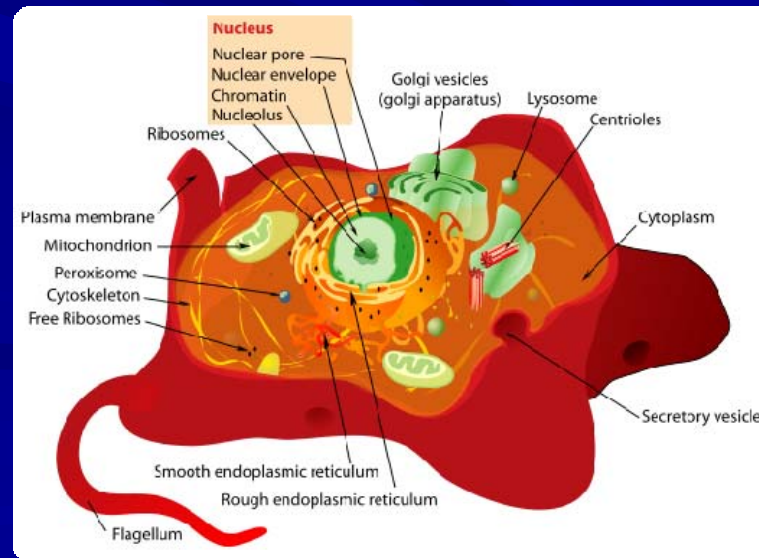


Types of Cells

Prokaryote



Eukaryote





HEAT 5/14

4/21/18

So how do you tell what kind of bacteria it is?

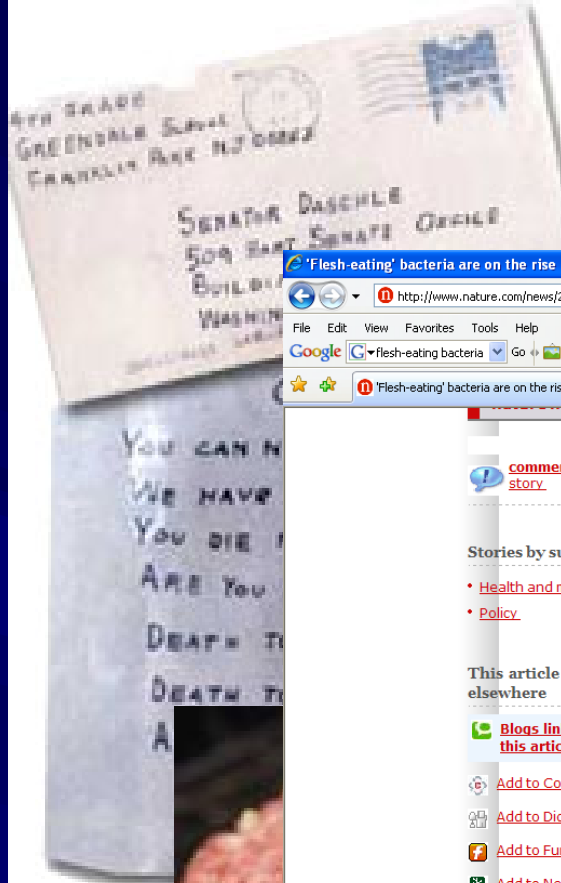
■ Genetic (DNA)?

- can be done but expensive, difficult, requires knowing a little what you are looking at

■ Antibodies

- how it reacts to things

In general, no easy, quick way to do it!



'Flesh-eating' bacteria are on the rise : Nature News - Windows Internet Explorer

http://www.nature.com/news/2004/040913/full/news040913-22.html

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'Flesh-eating' bacteria are on the rise : Nature News

Published online 17 September 2004 | Nature | doi:10.1038/news040913-22

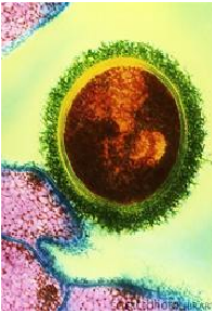
News

'Flesh-eating' bacteria are on the rise

European monitors reveal prevalence of fatal infections.

Alison Abbott

The harder you look, it seems, the more you find... and it won't always be good news. A European research network has found that life-threatening infections with group A *Streptococcus*, also known as 'flesh-eating bacteria', are much more frequent than had been thought.



Most group A streptococcal infections are benign. But some can chew through organs or tear holes in blood vessels.

© SPL

Scientists in 11 countries, led by microbiologist Aftab Jasir at Lund University in Sweden, have been systematically searching for these infections. When they started the project in 2002 they expected to find 1,000 cases in the first 18 months. Instead they found 5,000.

"There had been little surveillance in countries like Italy, Cyprus and Romania," says Jasir. These countries initially claimed they had very few cases. "But when everybody started to look systematically, it turned

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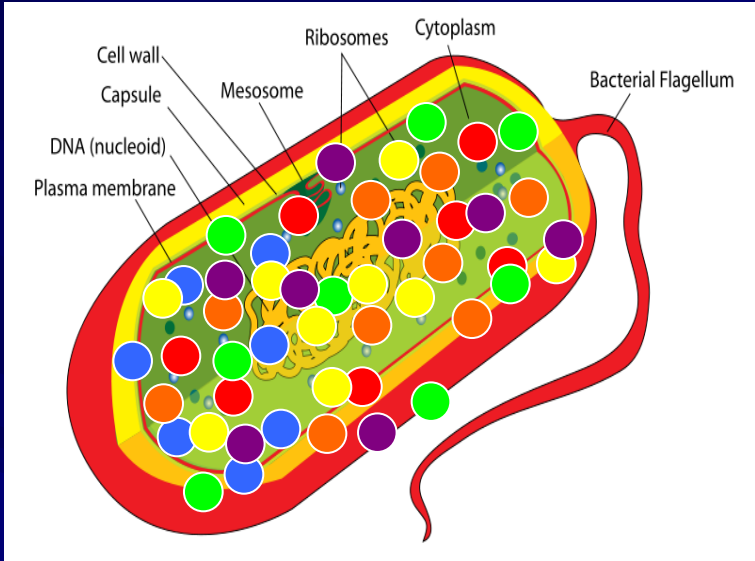
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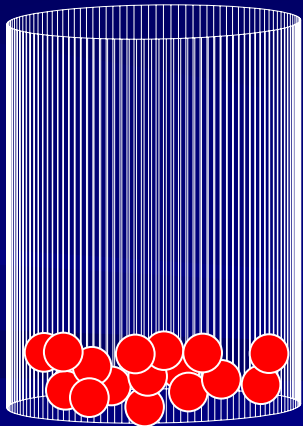
start | Inboxes - Microsoft... | 'Flesh-eating' bac... | Microsoft Excel | C:\conferences a... | F:\ | Microsoft PowerP... | RE: Award Cere... | Internet | 110% | 6:56 PM

So my question is/was...
hypothesis

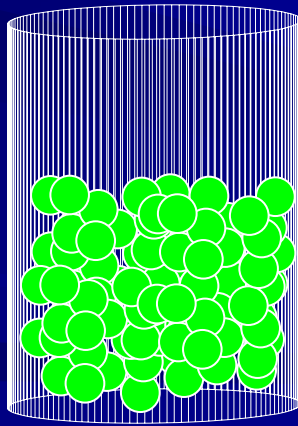
- Can a bacteria be rapidly identified by knowing the amount and type of all the atoms in it?



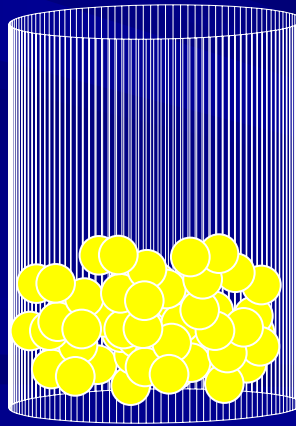
calcium



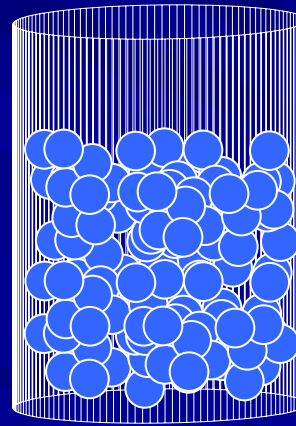
magnesium



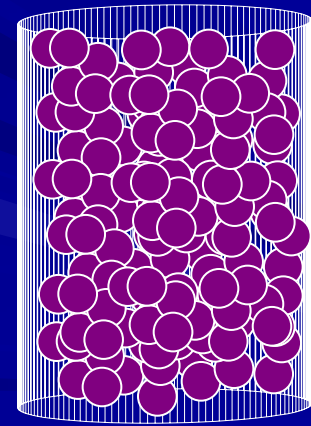
sodium

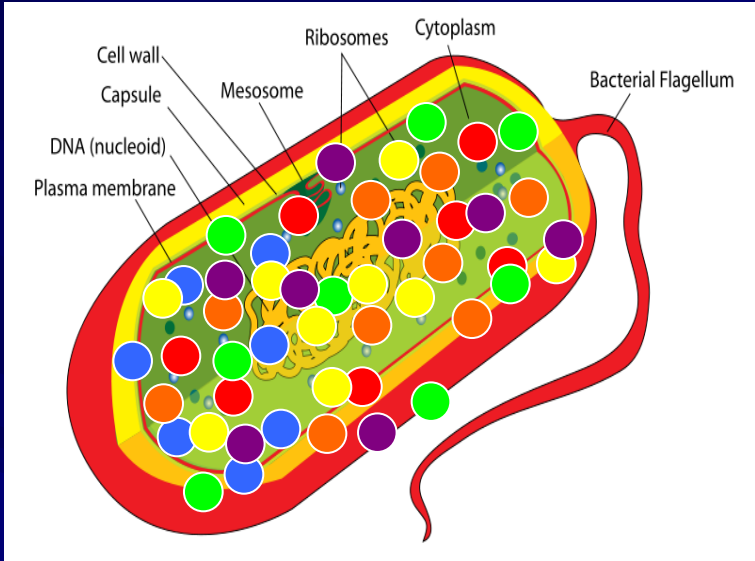


phosphorus

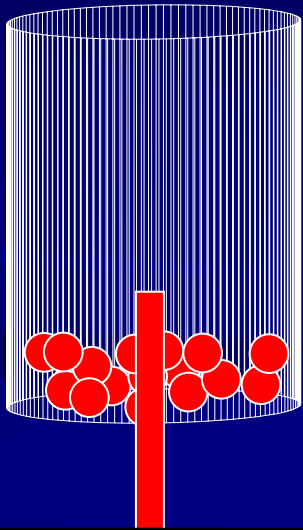


carbon

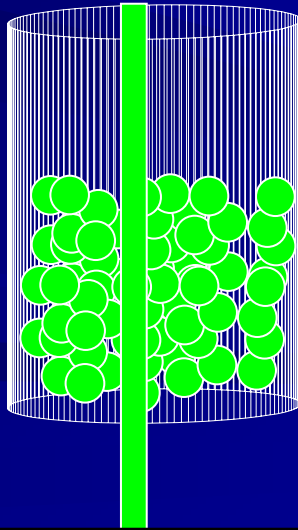




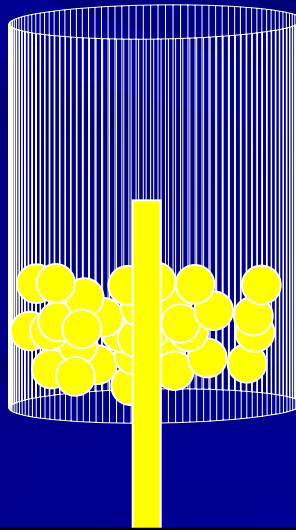
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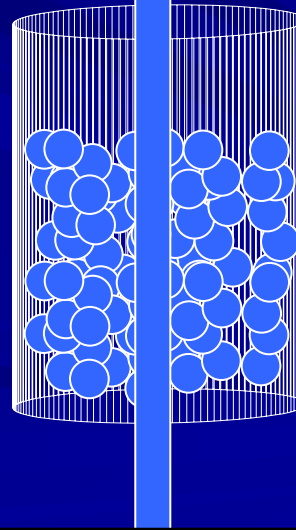
magnesium



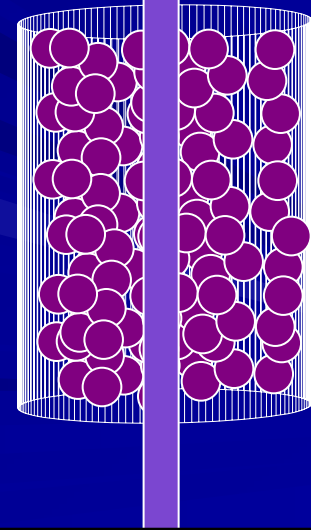
sodium

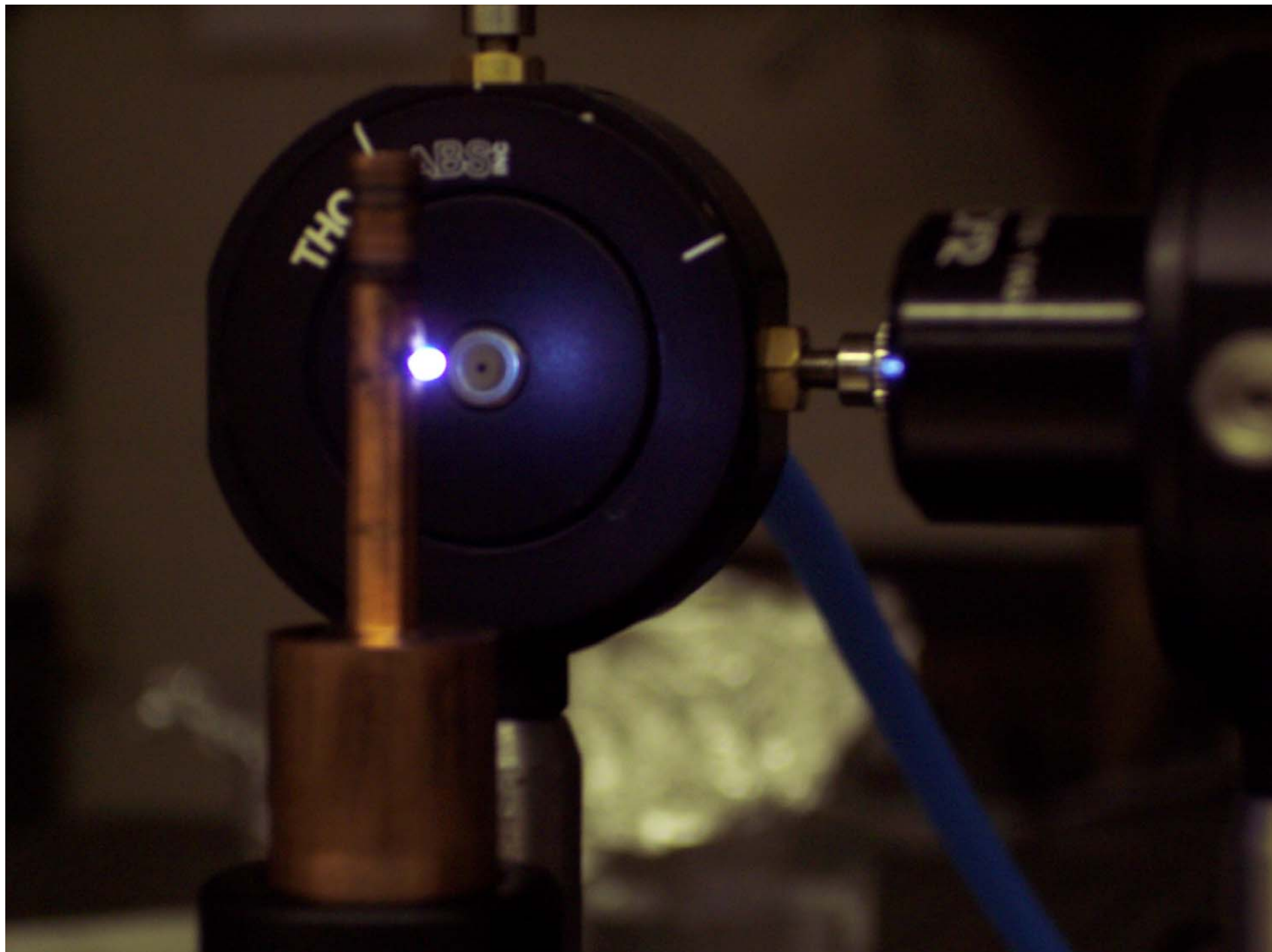


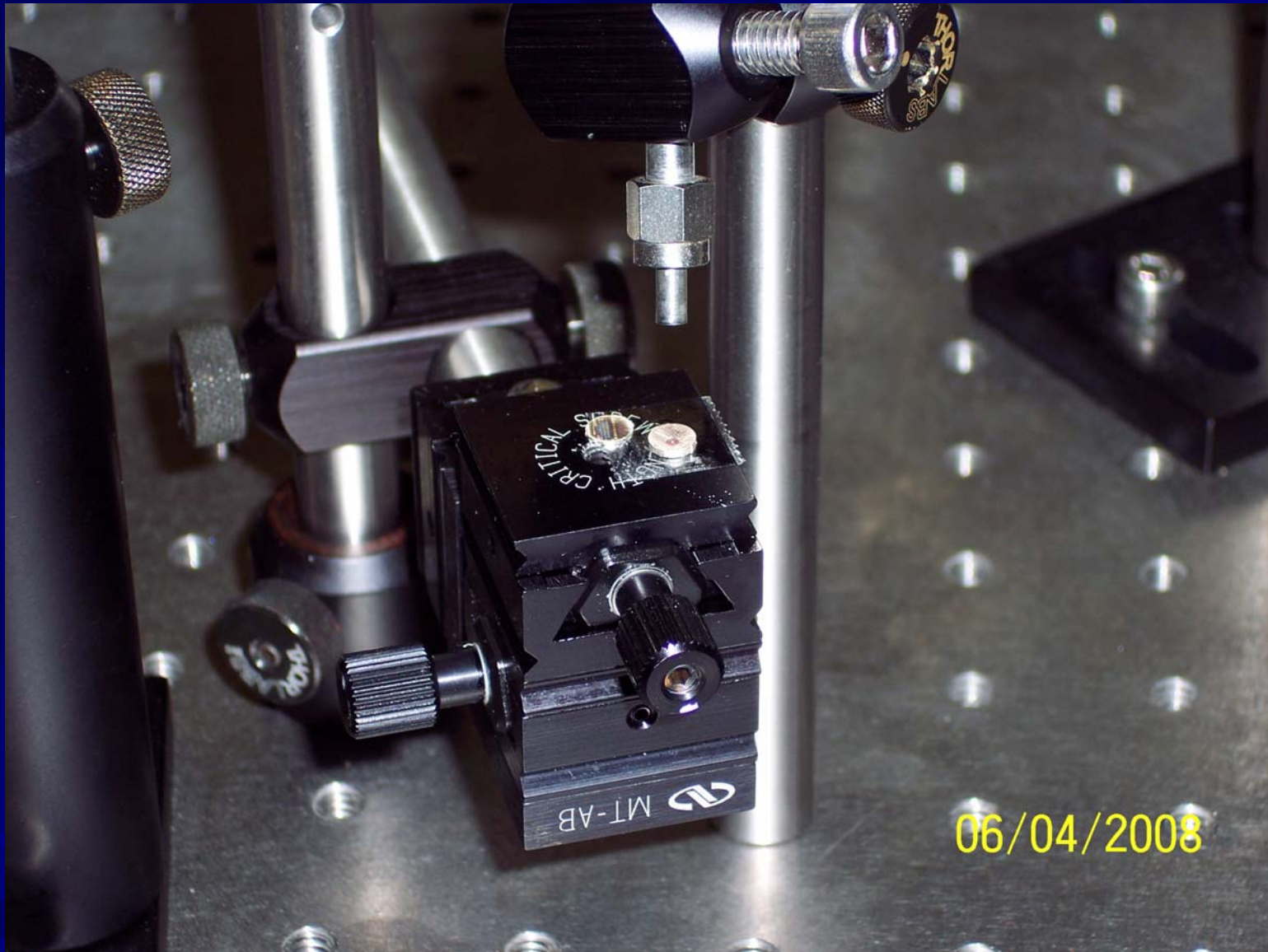
phosphorus



carbon

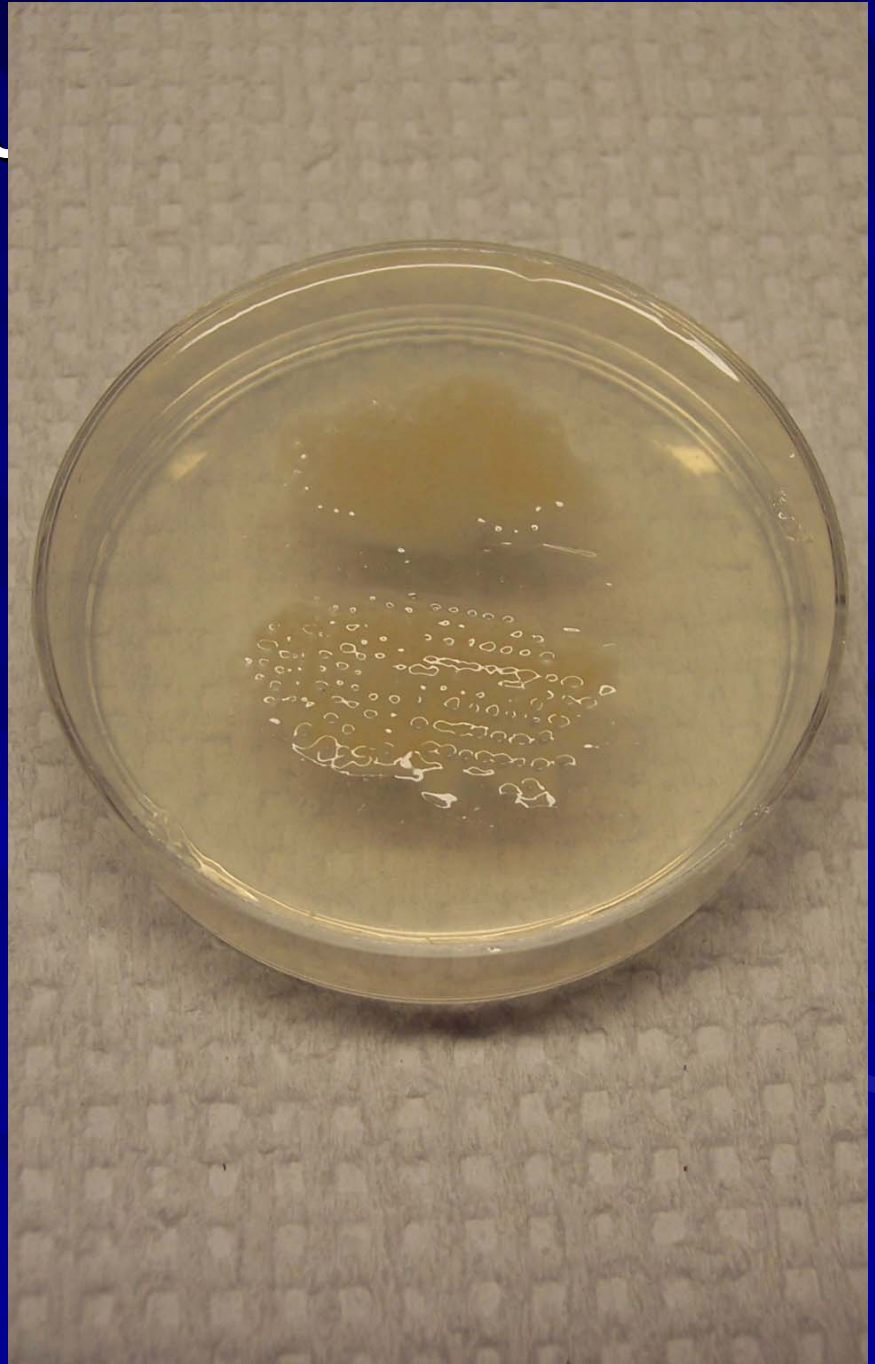




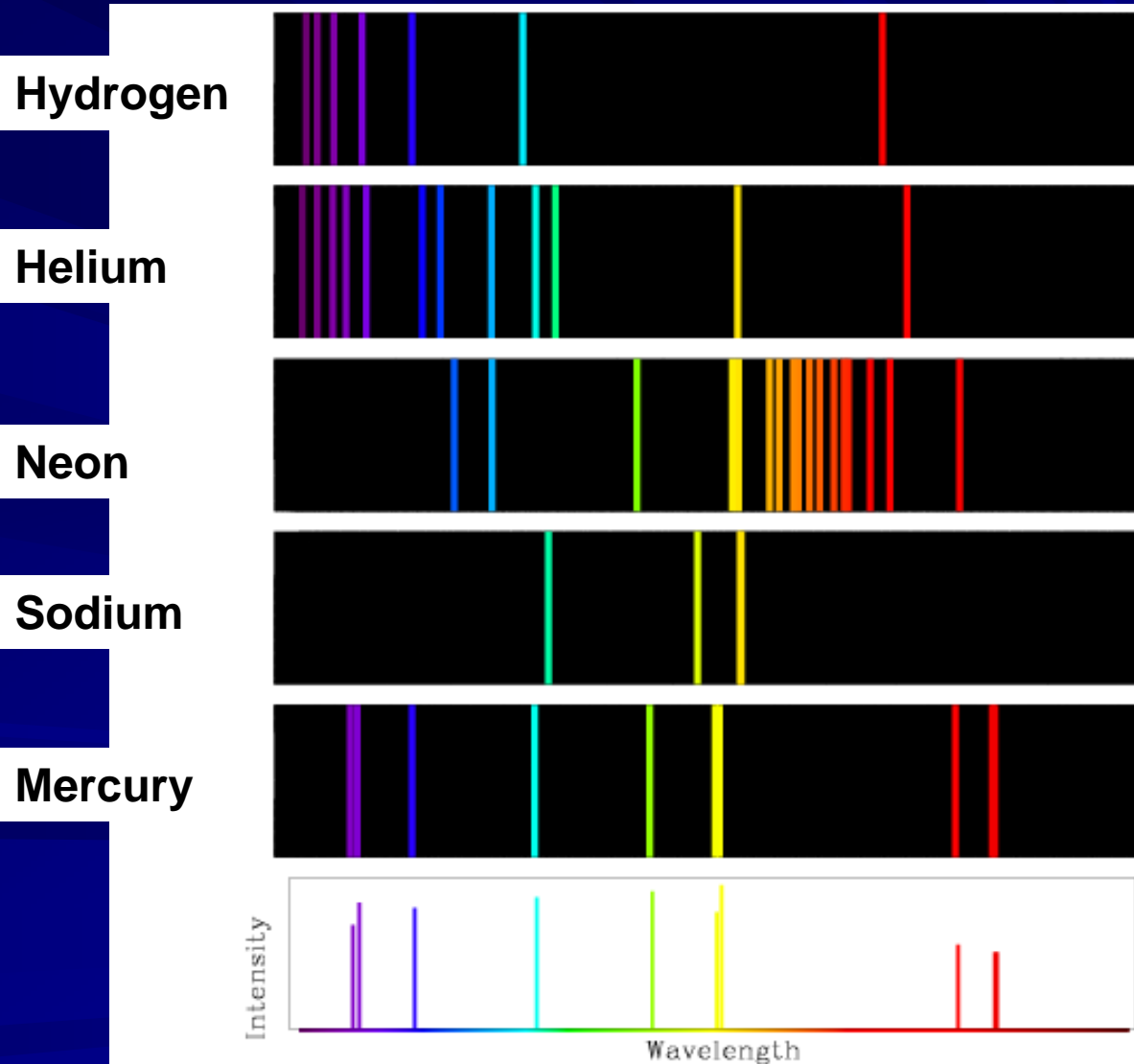


movie

Nu

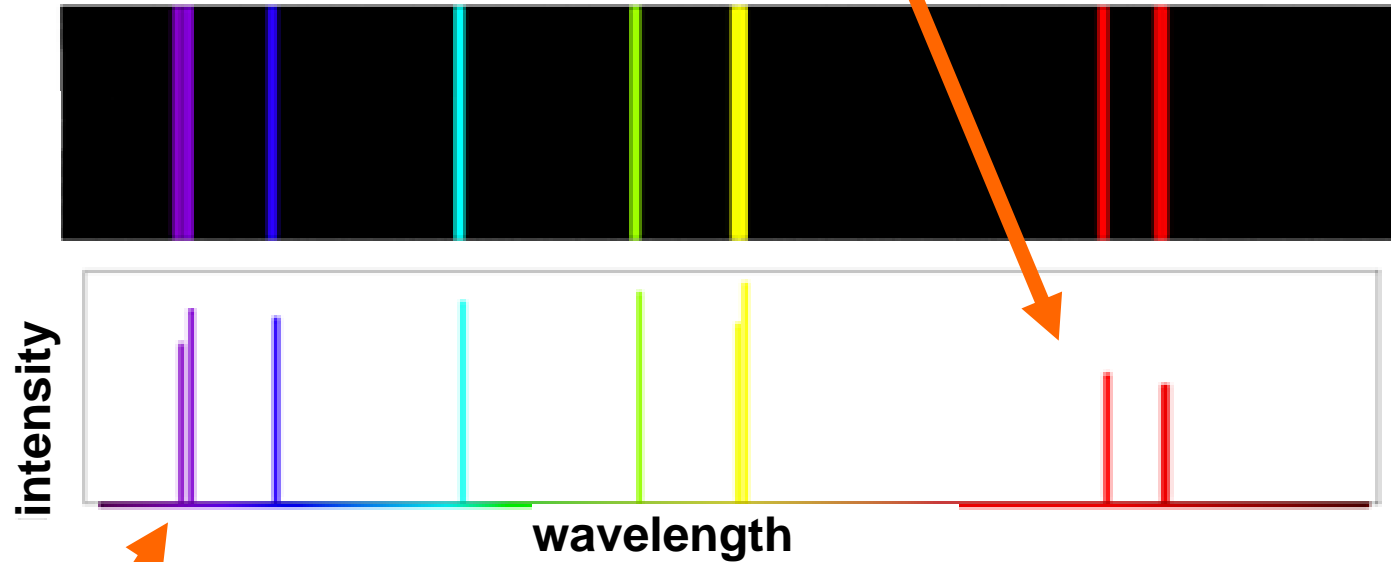


We analyze that light (spectroscopy)

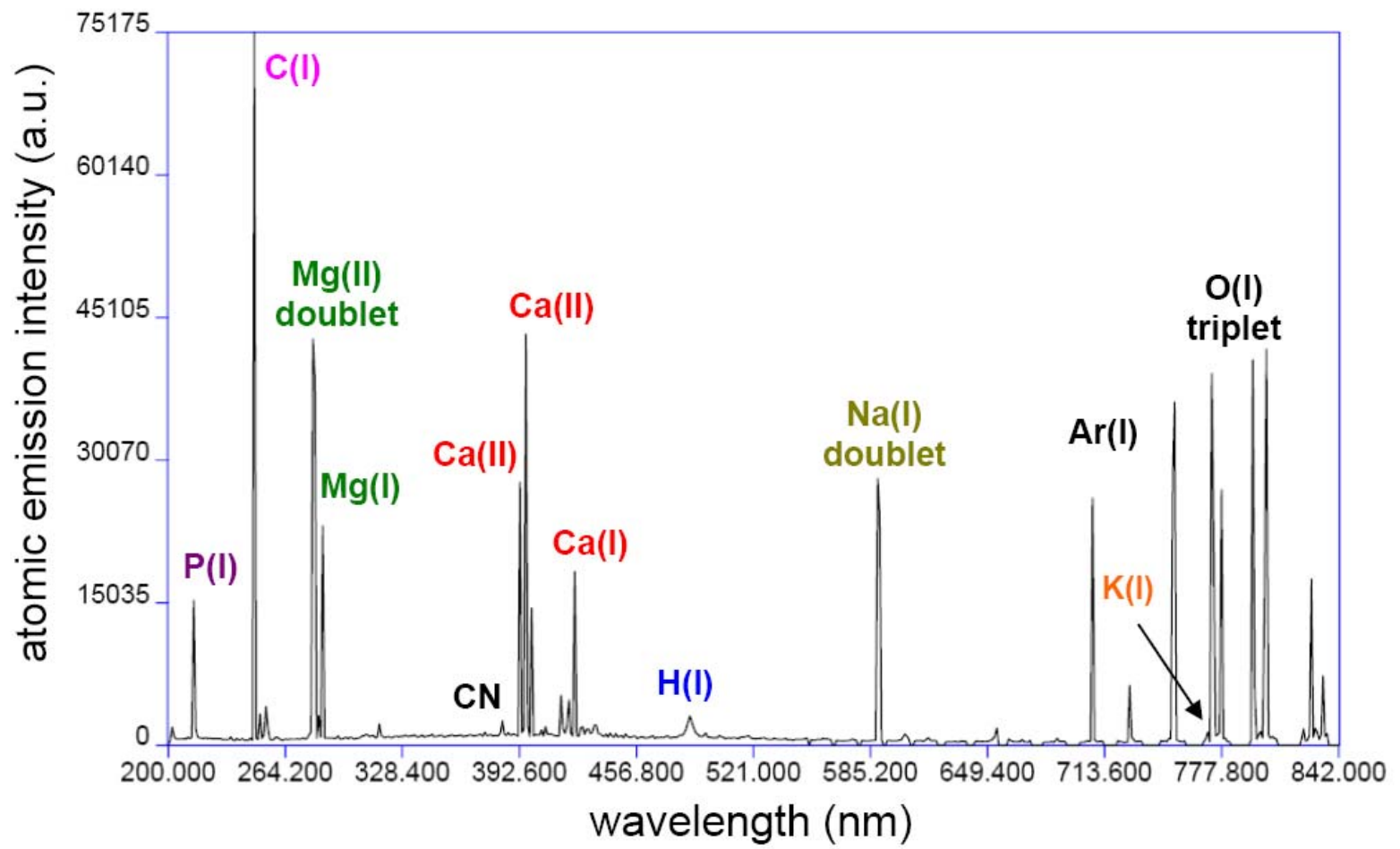


how tall the peak is means something

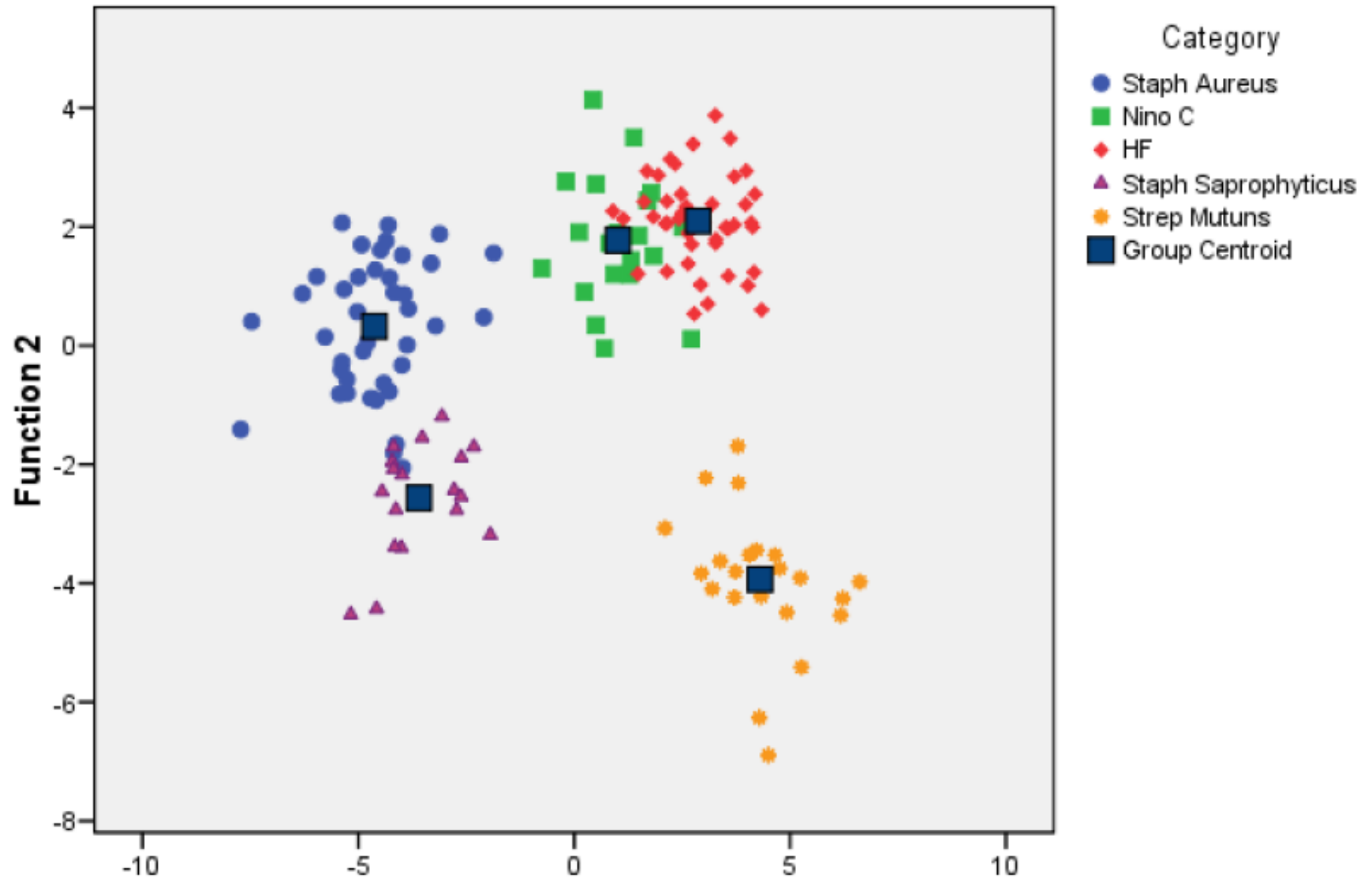
Mercury



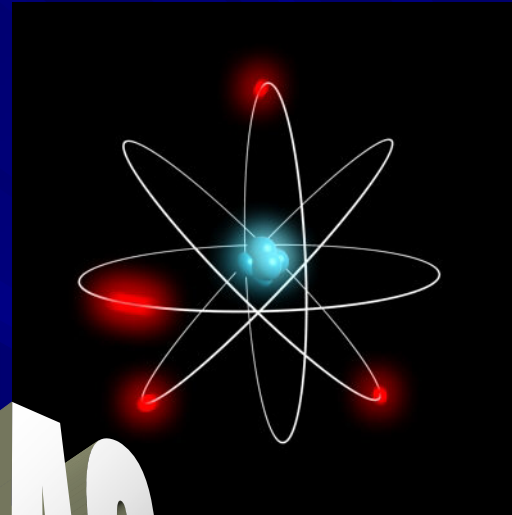
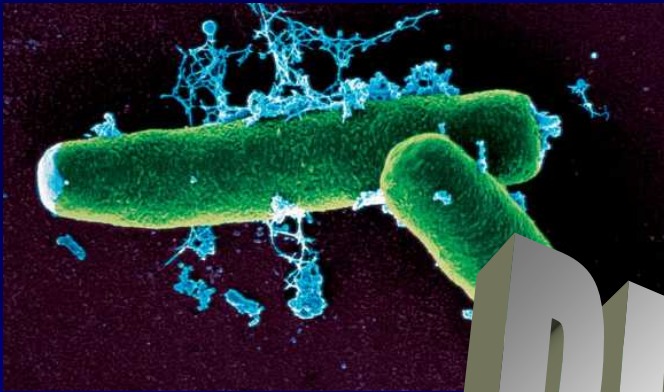
where the line is means something



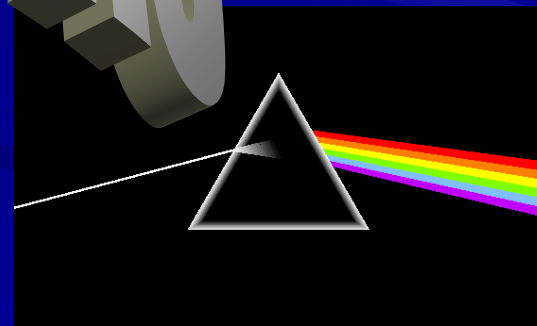
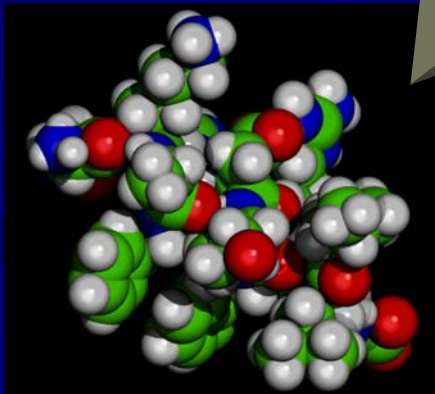
And the result is...
IT WORKS!!



The BIOMAS Project: Bacteria Identification by Optical, Molecular, and Atomic Spectroscopy



BIOMAS



MP-LIBS

A full laboratory High-Resolution
Broadband LIBS system in a portable backpack

Head's-up display

Backpack contains
broadband high-
resolution
spectrometer, laser
power supply,
computer, and battery

Hand-held probe contains
laser, joystick for control,
and focus optics

Microplasma/
LIBS Event



courtesy of Ocean Optics.



courtesy of Applied Photonics Ltd, U.K.

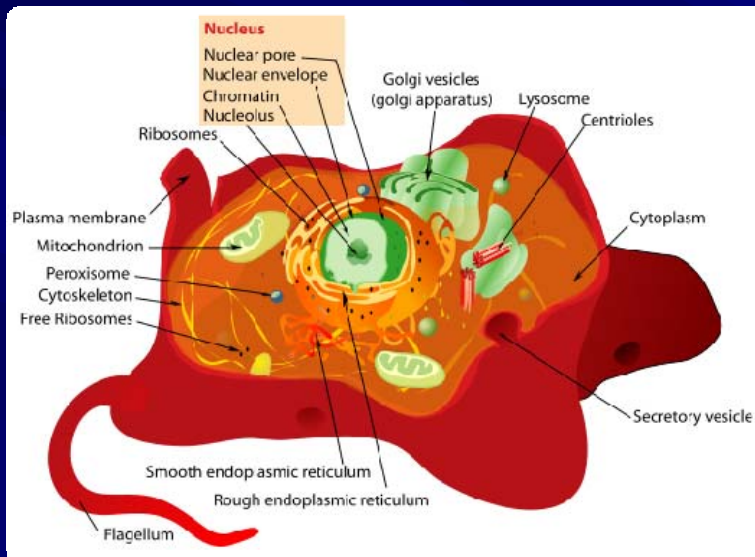
And on into the future...

Thank you.

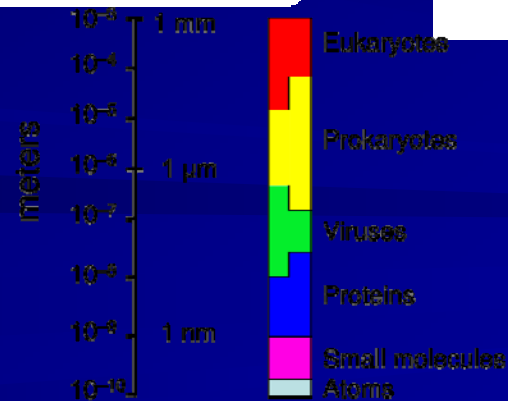
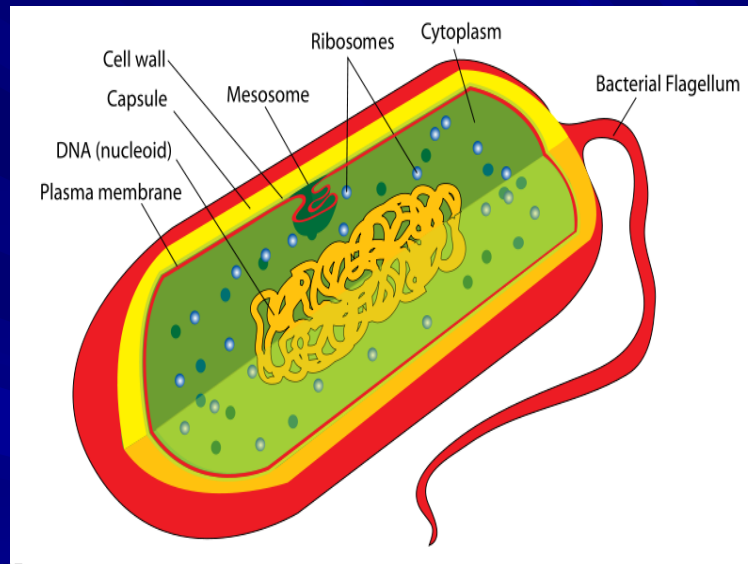
Questions?

Types of Cells

Eukaryote



Prokaryote



Bacteria

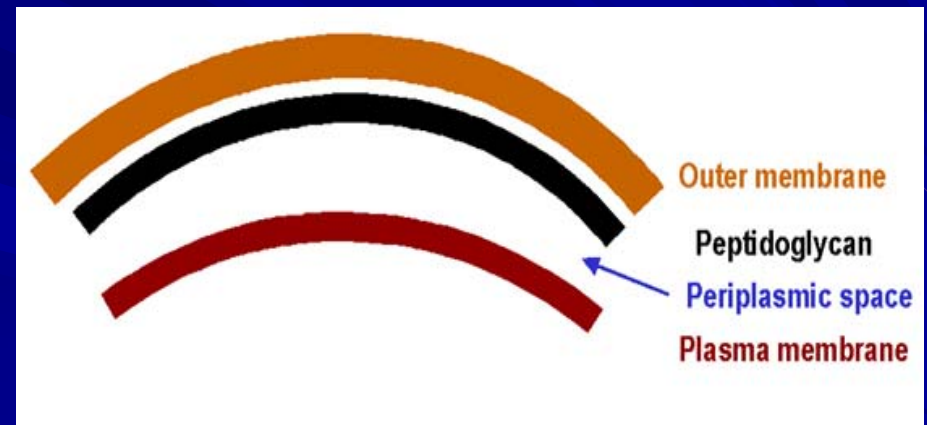
Prokaryote (no nucleus)

Gram-positive



- Thick cell wall
- No outer membrane
- No periplasm

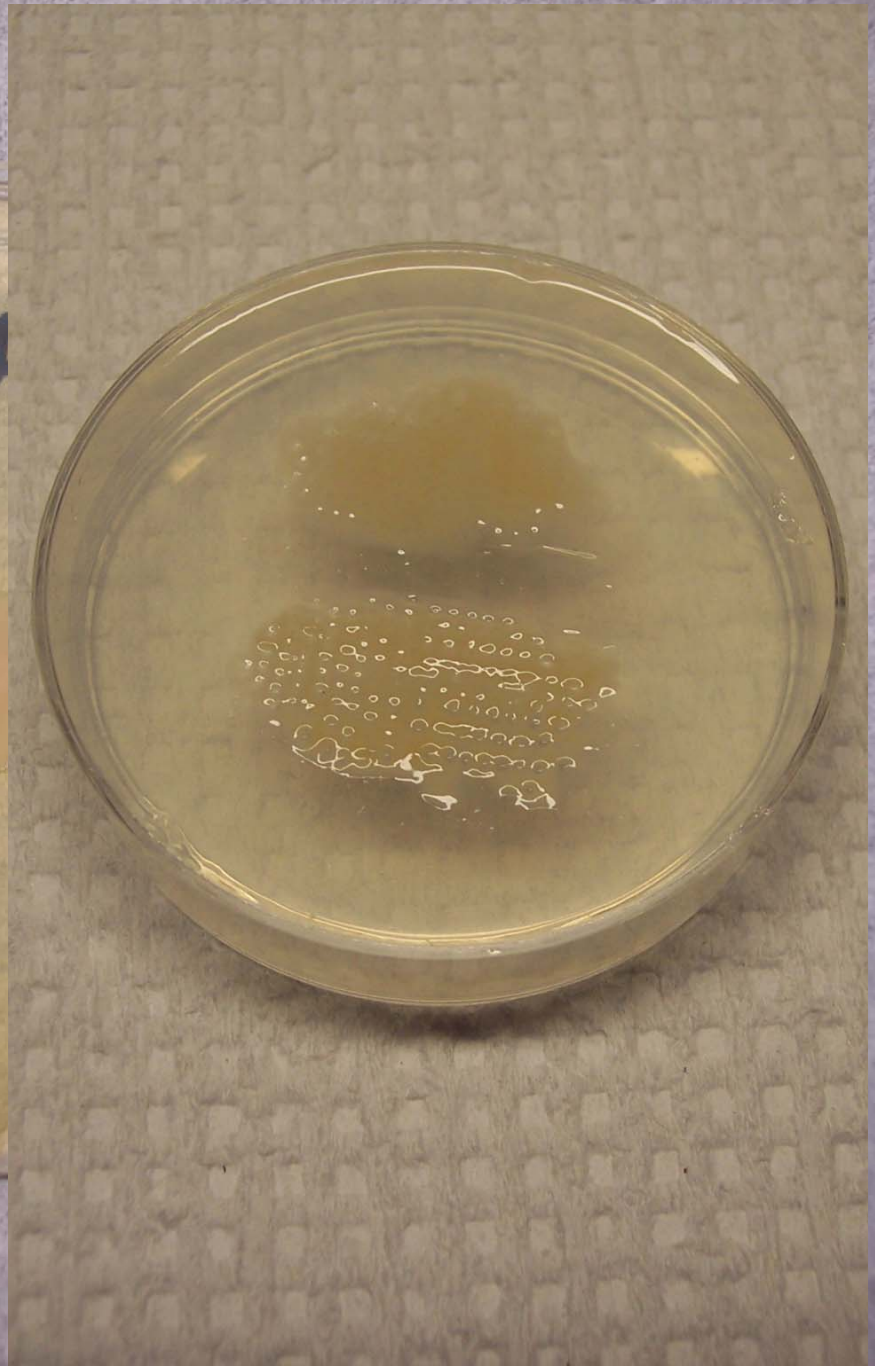
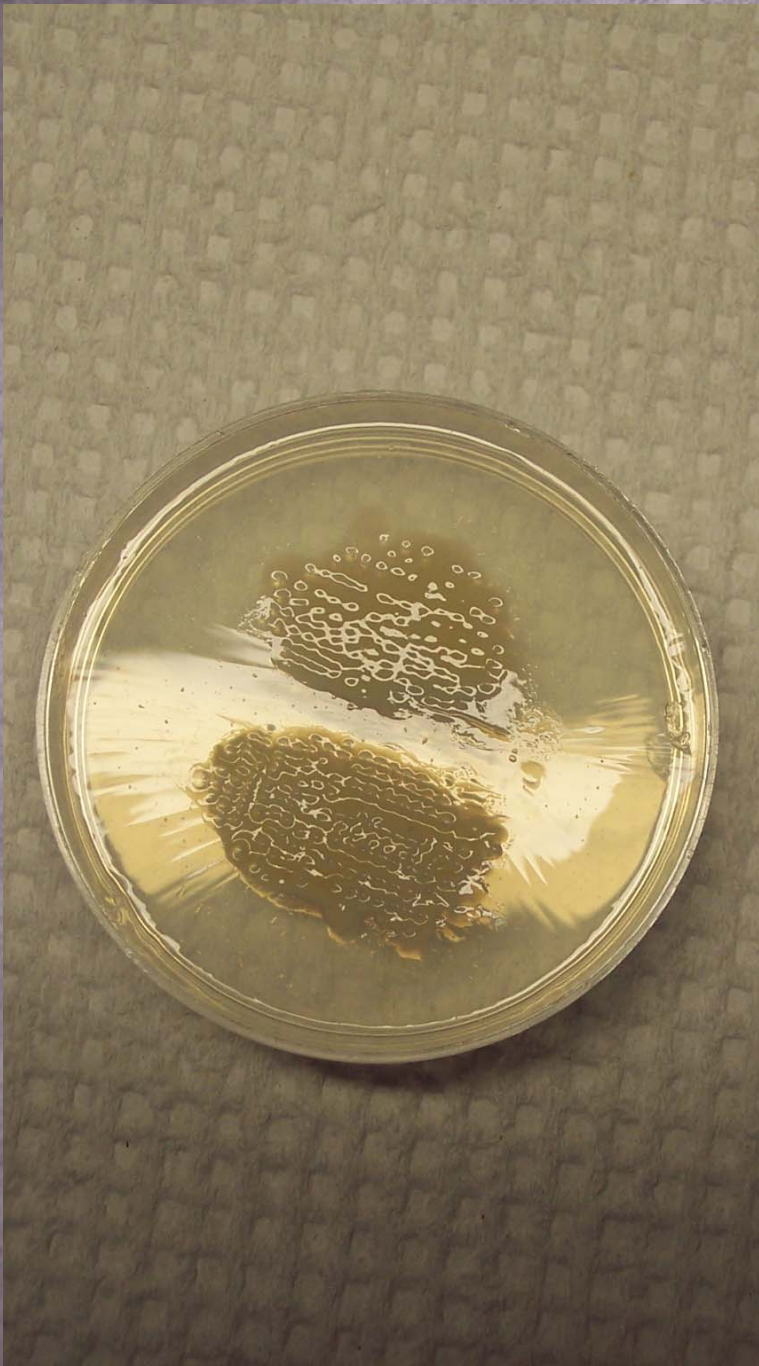
Gram-negative

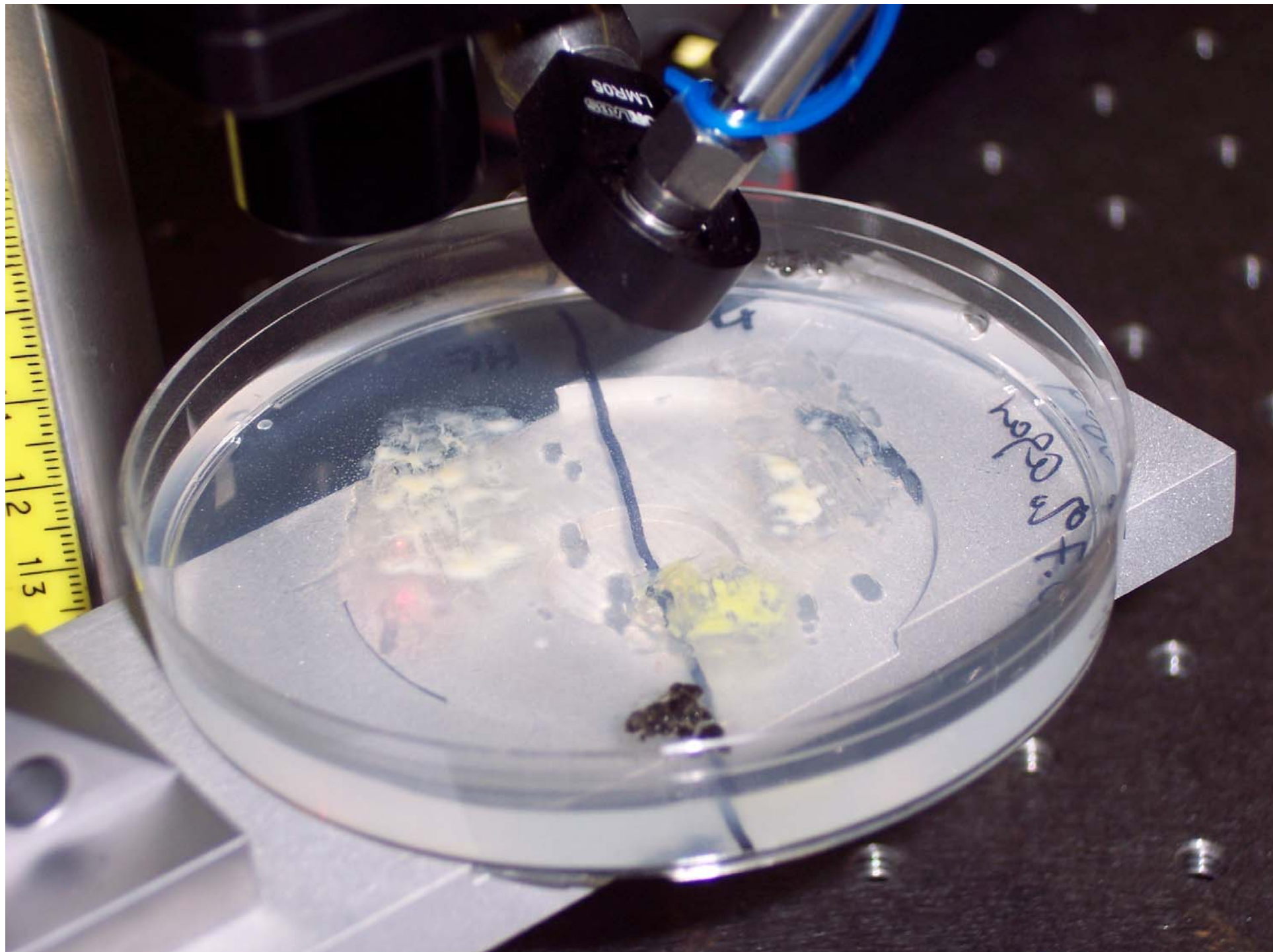


- Outer membrane
- Periplasm

Example:

- Escherichia coli (Nino C, HF 4714, AB)
- Pseudomonas aeruginosa





E. coli Spectrum

