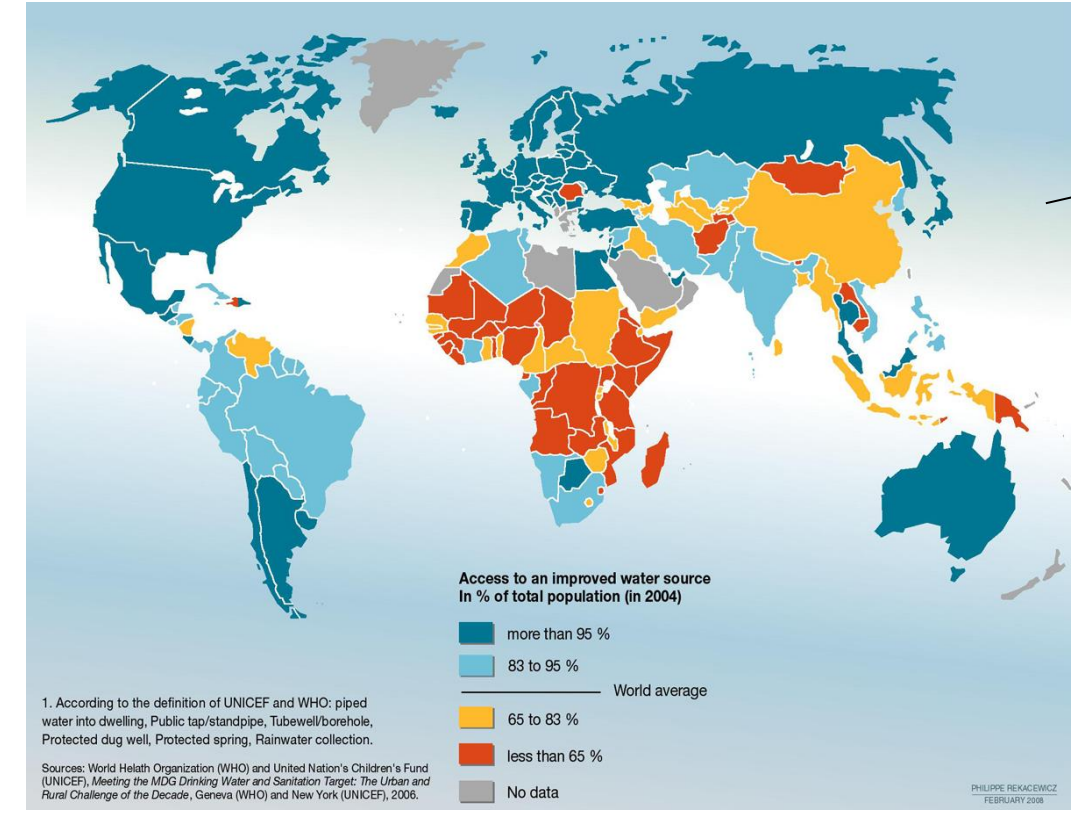




**Background**

Access to safe drinking water is a growing global issue:



Over a billion people lack access to safe drinking water

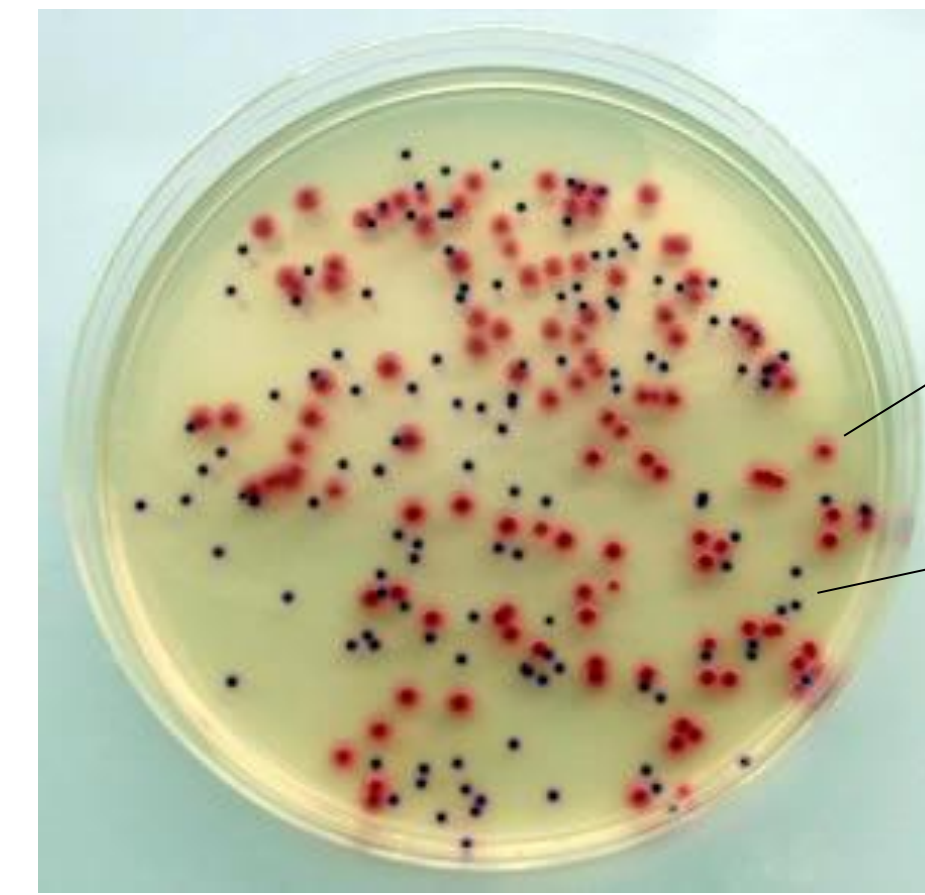
3.4 million deaths annually from contaminated water

Disproportionate impact on the young

Standard biological assessment of water quality is inadequate:

Standard biological water quality tests rely on growth of indicator bacteria such as coliforms (routine inhabitants of the gut of warm-blooded organisms)

- Indirect assay
- Limited to culturable bacteria
- Requires 24-48 hours
- Uncertain host
- Poor correlation with observed disease



Coliform

*E. coli*

**Alternative water quality assessment:**

Although a variety of new approaches are being pursued in better evaluating water quality, some of the most promising involve the use of light-based systems. One such device is an interferometric reflectance imaging sensor (IRIS) employed in the research discussed below.

**Experimental work:**

**Objective-**

To examine the potential utility of using an LED-based sensor (IRIS) in assessing bacterial contamination of environmental samples.

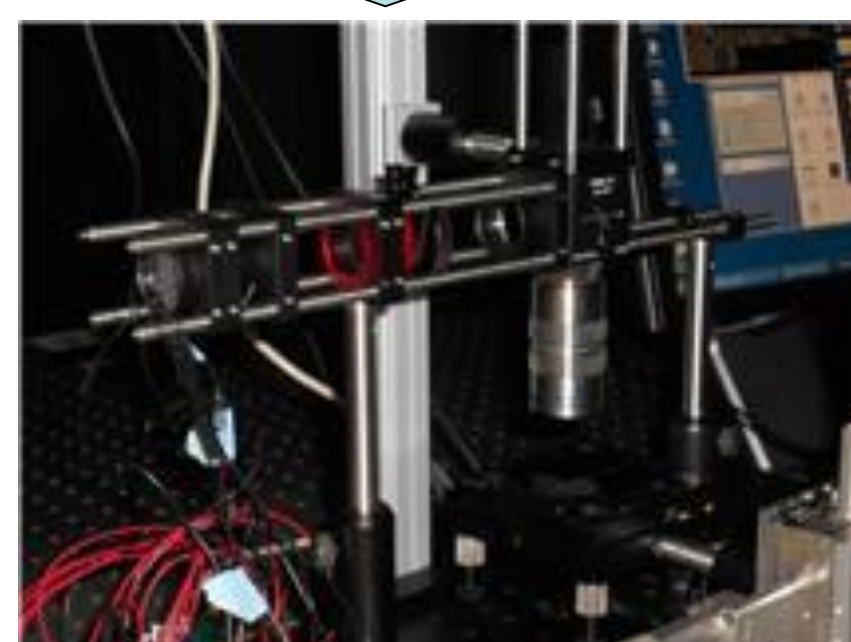
**Methodology-**

Employed two non-pathogenic strains of *E. coli* (ATCC 12435, 14948) as surrogates for their pathogenic counterparts

*E. coli* cultured in LB. Plated on LB agar for cell density estimates

Series of centrifugation and extraction steps to lyse cells

Supernatant from final centrifugation step then incubated on Si chip that had been previously spotted with *E. coli* antibody and run on the IRIS.



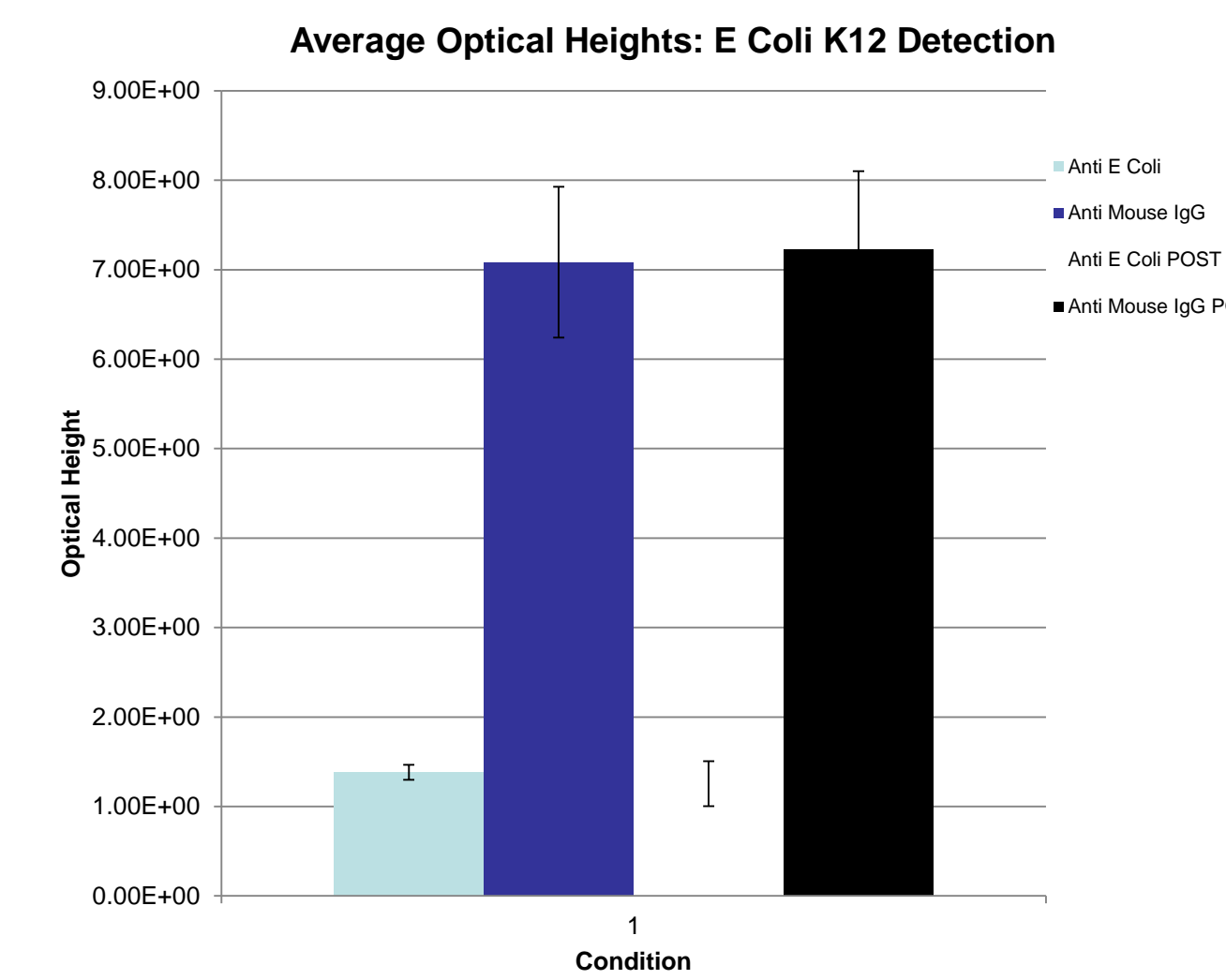
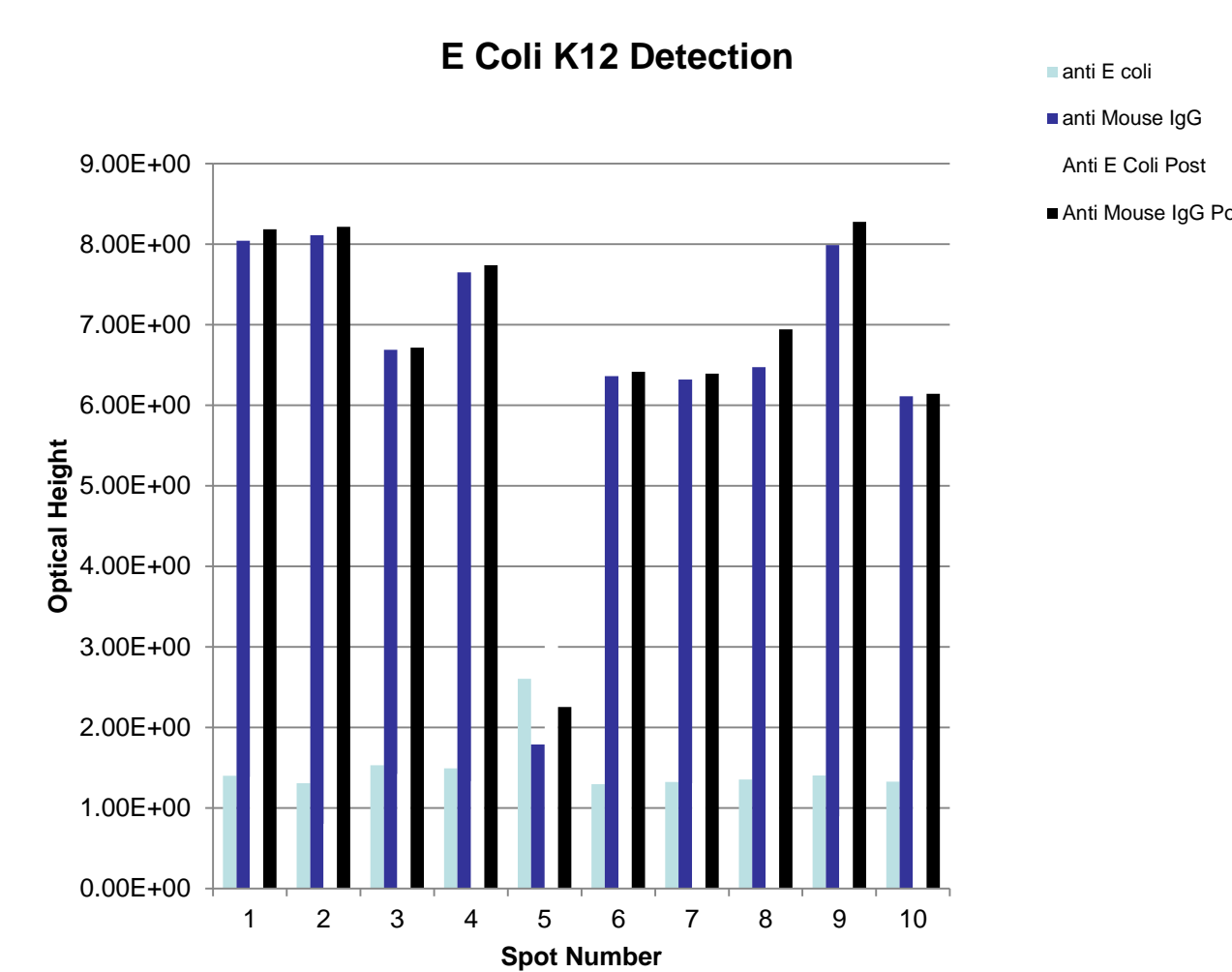
**Safe to Drink?**



**Results-**

**First trial:**

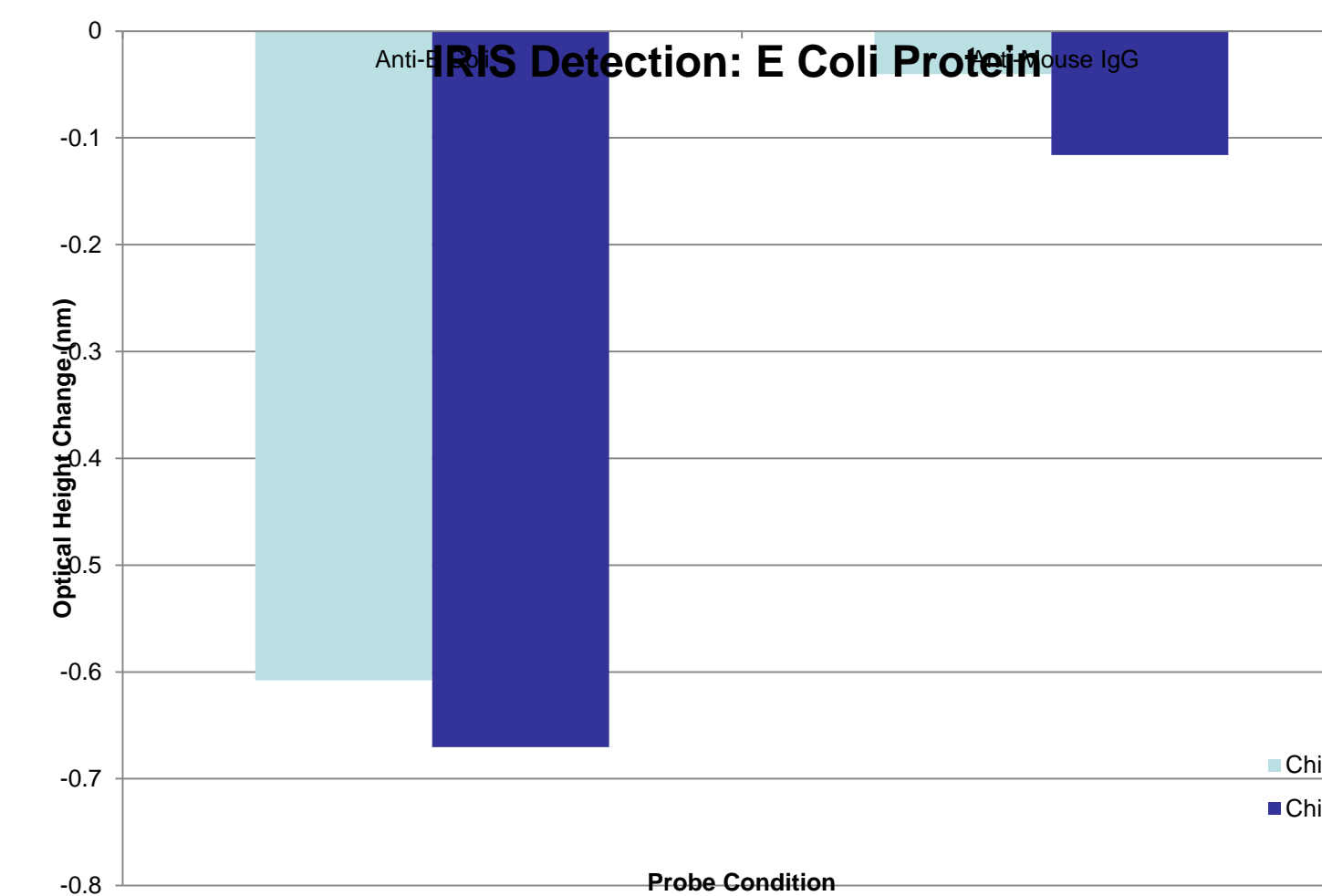
- Only one *E. coli* strain (ATCC 12435) employed
- Standard cell lysis protocol utilized



- Significantly reduced *E. coli* antibody binding relative to its mouse counterpart was noted.
- No apparent binding of the *E. coli* lysate to the mouse IgG antibody
- However, no binding of the *E. coli* lysate to its antibody was observed.

**Second trial:**

- Both *E. coli* strains (ATCC 12435, 14948) were employed
- Used modified cell lysis protocol, i.e. freeze/thaw cycles



- Not only was there again no binding of the *E. coli* lysate to either the *E. coli* antibody or to the mouse antibody, but there was an apparent loss of bound antibody that was particularly pronounced in the case of the *E. coli* antibody.

**Summary:**

- Although no apparent binding of *E. coli* lysate to its corresponding antibody was observed in either trial, and during the second trial there may have been reduced binding or retention of the antibody to the coating of the chip, these results may reflect different binding kinetics by the *E. coli* antibody relative to the mouse antibody control.
- The lack of a positive control makes it difficult to assess *E. coli* lysate:antibody binding within the parameters of the experimental conditions.
- The steps in the processing of the bacterial cells in generating a whole cell lysate need to be further investigated and optimized.
- Nonetheless, the LED-based IRIS system has great potential for the rapid and efficient assessment of biological contaminants in environmental samples under field conditions.

**Application to Teaching**

**Target audience-** APES, AP Biology (High School)

**Format –** 2/3 class periods, PBL centered, of standard versus emerging, i.e. light-based, methodologies in assessing water quality

**Objective –** The goal is for the students to examine a significant and complex environmental issue using a variety of learning resources

**Lesson plan**

Students are introduced to global water quality issues

Acting as consultants, the students are charged with determining bacterial contamination in two potential water sources

Lab 1 – The students plate out water samples on agar selective for coliform bacteria, i.e. standard water quality methodology

Lab 2 – The students evaluate their plates from the prior lab. They then investigate using a simulated light-based sensor system using chemical surrogates with laser light absorption assessed with Vernier light probes, i.e. alternative water quality methodology

**Photo credits:**

Map: nsc.sca.nsw.gov.au  
Plate: raapidmicrobiology.com  
Boy drinking: water.org