INTRODUCTION

• General lab rules
• Microbiology and Water Quality
• Measurements
• Pathogens vs. indicator microbes
• Sample collection
• Analysis
LAB RULES

• ABSOLUTELY NO eating, drinking, smoking, handling contact lenses or applying cosmetics

• Gloves must be worn at all times when working with samples.

• Lab coats are worn while in the lab.

• Closed-toed shoes must be worn while in the lab, no sandals allowed!

• Eyewash station, shower and fire extinguisher outside Room 148.

LAB RULES CONTINUED

• Mouth pipetting prohibited.

• Wash your hands after removing gloves and before leaving the lab.

• Work surfaces are decontaminated with 70% ethanol before and after experiment.

• Sample containers, pipets, beakers, etc... are decontaminated by autoclaving.

• Report spills and accidents immediately to the lab manager.
WHAT IS MICROBIOLOGY?

- the study of microscopic organisms, which are defined as any living organism that is either a single cell (unicellular), a cell cluster, or has no cells at all (acellular)

- Microbiology is a broad term which includes virology, mycology, parasitology, bacteriology, immunology and other branches.

- A microbiologist is a specialist in microbiology and these related topics.

WATER QUALITY

- Water quality is a term used to describe the chemical, biological, and physical characteristics of water.

- Water quality is not simply "good" or "bad", but usually is applied to its allotted use. For example, water quality may refer to water for agriculture, reclamation, and irrigation.

- Chemical tests have been developed to determine water quality.

- There are many factors that can affect water quality such as pH, dissolved oxygen, temperature, and salinity.
TYPES OF MEASUREMENTS TO DETERMINE WATER QUALITY

• Chemical
  • Metals, organic compounds, pesticides, herbicides, nutrients, etc.

• Physical
  • Temperature, pH, turbidity

• Microbial
  • Bacteria, viruses and parasites

PH

• pH is a measure of a sample’s acidity and is the most commonly used water quality test.

• pH is a measure of the hydrogen ion concentration, which is high in acids and low in bases.

• pH = \(-\log[H^+]\)

• pH is measured on a logarithmic scale from 1 to 14, with 1 being the highest concentration of H+ (most acidic) and 14 the lowest (most basic).
TEMPERATURE

- Temperature is important to the plants, animals, and microorganisms that live within the water.

- Extreme changes in temperature can place stress on the organisms within an ecosystem.

- Therefore, temperature is important to aquatic plants and animals and the overall health of the watershed.

SEDIMENT POLLUTION (TURBIDITY)

- Sediment pollution occurs when loose soil is carried off streets, parking lots, buildings, and construction sites by rain.

- When these particles enter the water, they clog the gills of fish, and decrease the amount of sunlight available to aquatic plants.

- Sediments are also dangerous because they carry other pollutants such as chemicals from lawns and petroleum products from automobiles.
TYPES OF WATERBORNE PATHOGENS

What is the definition of a pathogen?

Viruses  Bacteria  Parasites

A pathogen is something that causes a disease

MICROORGANISMS

• Three types:
  • Bacteria – E. coli, Salmonella, Vibrio cholera
  • Viruses – rhinovirus, norovirus, rotavirus
  • Parasites – Cryptosporidium, Naegleria

• Pathogens cause disease. These microorganisms can also be shed in the feces of humans and animals.
KEEP IN MIND…

- Not all bacteria present a health risk
- Most will not make you sick, but some may
- Low infectivity rates

ENTERIC PATHOGENS

- Exposure is via ingestion
- Primary site of infection is gastrointestinal tract
- Gastroenteritis symptoms
  - nausea
  - vomiting
  - diarrhea
  - fever
- May spread to other sites (blood, liver, nervous system)
- Shed in fecal material
- “Fecal-oral” route of transmission
HOW CAN WE TELL IF WATER HAS BEEN TREATED PROPERLY?

**Indicator Bacteria**

**INDICATOR MICROORGANISMS**

- **Total coliforms** – ferment lactose and produce gas at 37°C:
  - Citrobacter
  - Klebsiella
  - Enterobacter
  - Escherichia

- **Fecal coliforms** – ferment lactose and produce gas at 44.5°C (body temp.):
  - Escherichia
  - Klebsiella

Indicates fecal contamination if fecal coliforms are present; could also indicate pathogens are present; used as a water quality indicator. E. coli is used as a national standard by water utilities for drinking water and wastewater quality.
CRITERIA FOR AN IDEAL INDICATOR

- The organism should be useful for all types of water.
- The organism should be present whenever enteric pathogens are present.
- The organism should have a reasonably longer survival than the hardiest enteric pathogen.
- It should not grow in water.
- Testing method should be easy to perform.
- The density of the indicator organism should have some direct relationship to the degree of fecal pollution.
E. COLI ARE USED AS INDICATORS BECAUSE THEY:

- Indicate fecal contamination
- Suggest the presence of pathogens
- Are easy to collect and analyze
- Are relatively safe to handle and generally harmless

WHY NOT SAMPLE FOR PATHOGENS?

- Few laboratories have the capacity
- It’s expensive
- Takes a long time for analysis
- Requires a large volume of water
- Most tests identify only one pathogen
- They are difficult to isolate and identify
WHAT IS E. COLI?

- *Escherichia coli* (*E. coli*) is a bacterium naturally found in the intestines and the feces of warm-blooded animals.
- Commonly used as an indicator of fecal pollution of water.
- Many different types of *E. coli*, most harmless, but some may cause illness

(e.g. foodborne outbreaks caused by *E. coli* O157:H7)

WHAT DOES E. COLI LOOK LIKE?
SAMPLE COLLECTION

- Types of bottles – size, plastic, glass, amber
- Holding times, sampling frequency
- Preservative
- Sterile?
- Pre-cleaned?
- Gloves
- Forms - chain of custody
- Always, let someone else know where and when you are leaving and expected to return
ACCURACY AND VARIABILITY

Results may not be accurate when:

- Samples aren’t kept cold
- Samples don’t reach lab within 6 hours
- Samplers are sloppy and don’t wear gloves
- Work space or equipment isn’t sterile
- Bottles and lids are contaminated
HANDS ON TIME!

- Three Stations
  - IDEXX Colilert - E.coli
  - Turbidity
  - pH/Conductivity

- Break off in teams of 4-5 students

- Rotate every 15 minutes

MICROBIOLOGY CAREERS

- Environmental research
- Agriculture and food
- Healthcare
- Quality Control
- Policy and regulation
- Product development
- Academia