The Centers for Disease Control and Prevention's Vessel Sanitation Program is proud to bring to you the following session:

The Microworld

While this presentation is primarily intended for cruise vessels under the jurisdiction of the Vessel Sanitation Program it may also be used by anyone who is interested in this topic.

This session should not be used as a replacement for existing interactive training but should be used as an adjunct to a comprehensive training program.

The Microworld

Vessel Sanitation Program

2007

Microworld Learning Objectives

- List the some of the major pathogens associated with illness
- List the major differences between bacteria, viruses, and parasites
- Identify the areas where microorganisms can be found
- Draw and label bacteria growth chart
- Describe why spores and toxins are a food safety concern

Microworld Learning Objectives

- List the growth needs of bacteria
- Define and list potentially hazardous foods (PHF)
- List the water activity level and pH level under which bacterial will not grow
- Identify the growth factors that are easiest to control and measure on a cruise vessel
- Describe the temperature danger zone and its relationship to bacterial growth

Pathogen

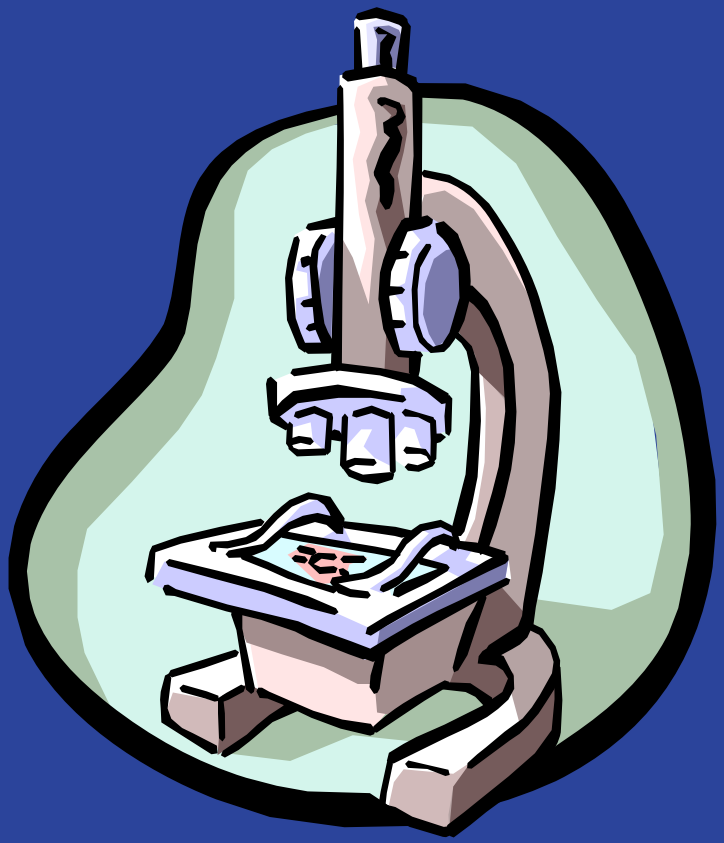
Definition: Any disease-producing agent

Pathogen Categories

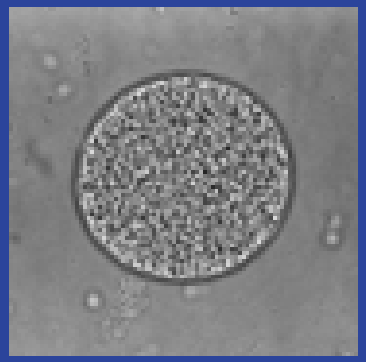
- Bacteria
- Viruses
- Parasites
- Fungi

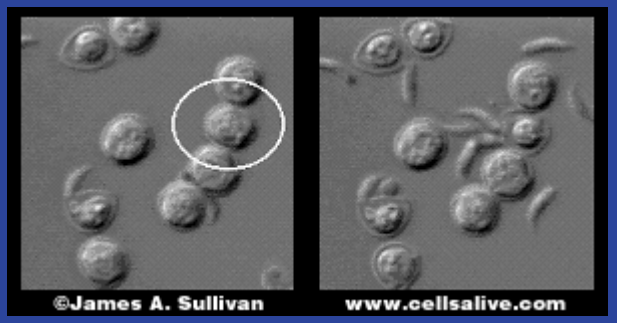
Microbes are found:

- People
  - Staphylococcus aureus
  - Shigella spp.
  - Hepatitis A and Norovirus
- Animals
  - Salmonella spp.
  - E. coli 0157:H7
  - Parasites
- Environment
  - Clostridium botulinum
  - Clostridium perfringens



Parasites



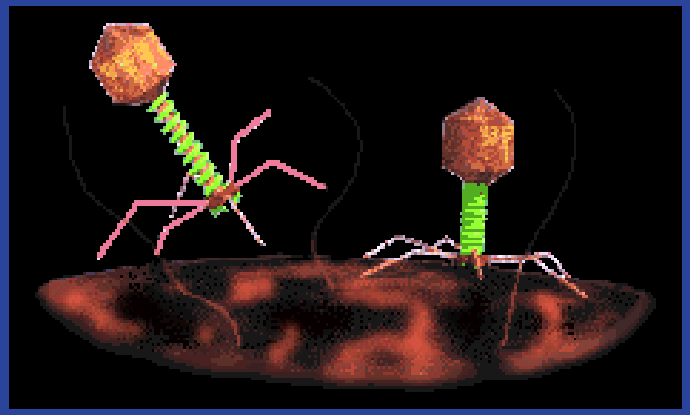


- Need a host
  - Nourishment
  - Protection
  - Complete life cycle
- Found
  - Soil
  - Water
  - Air
  - Animals
- Acquired via contaminated
  - Food
  - Water
  - Contact with a contaminated source

Parasites

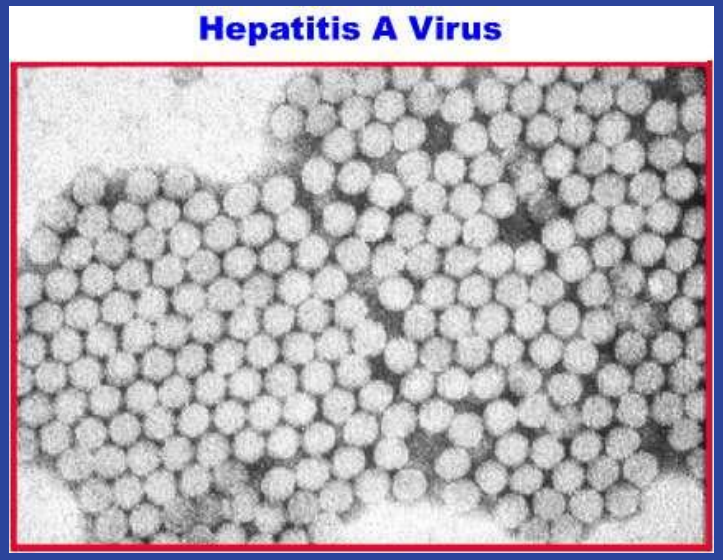
- Diseases
  - Anisakiasis
  - Giardiasis
  - Cryptosporidiosis
  - Trichinosis
  - Taeniasis

Viruses



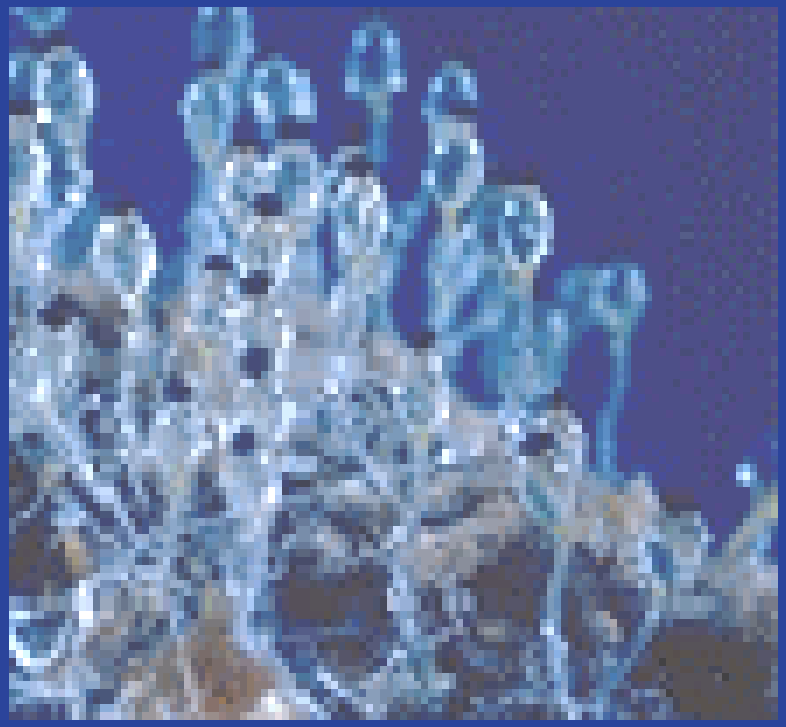
- Exist only to replicate
- Need a host
- Infect all types of cells
  - Bacteria
  - Fungi
  - Plants
  - Animals
- Environment
  - Soil
  - Water
  - Air

Viruses



- Viral diseases
  - Hepatitis A
  - Norovirus

Fungi

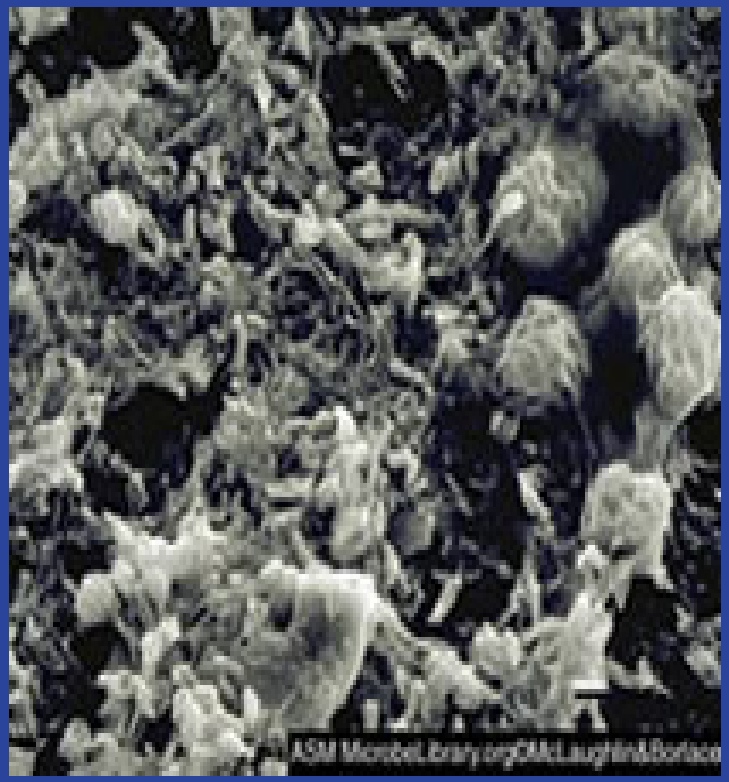


- Reproduce via spores
- Variety of shapes and sizes
- Include:
  - Yeasts
  - Molds

Fungi

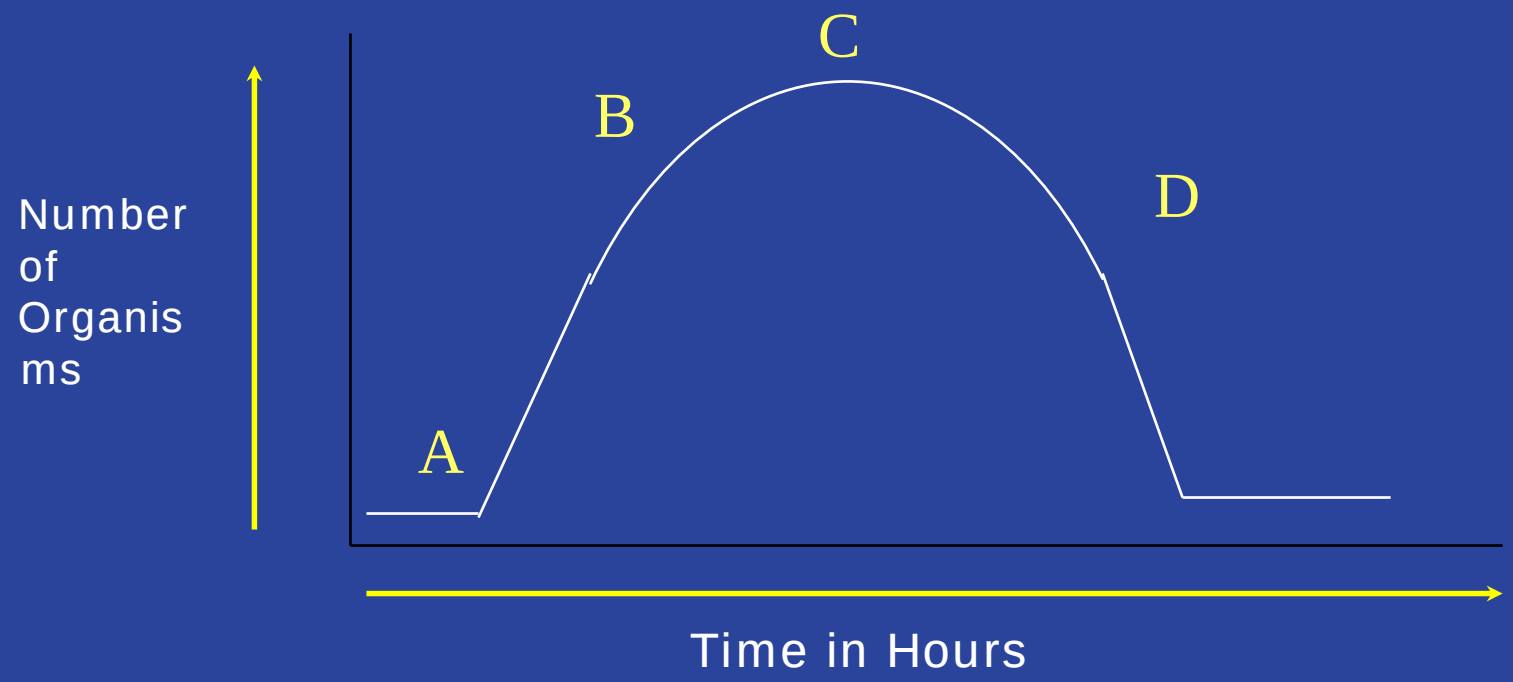
- Beneficial
- Spoilage
- Some are pathogenic

Bacteria



- Beneficial
  - Aid in digestion
  - Break down sewage
  - Food industry
    - yogurt
- Spoilage
  - Affects odor, taste and texture
- Pathogenic

Bacterial Growth Chart



A=Lag phase C=Stationary Phase
B=Log phase D=Rapid Decline

What phase do we want to eliminate?

What Bacteria Need To Grow..

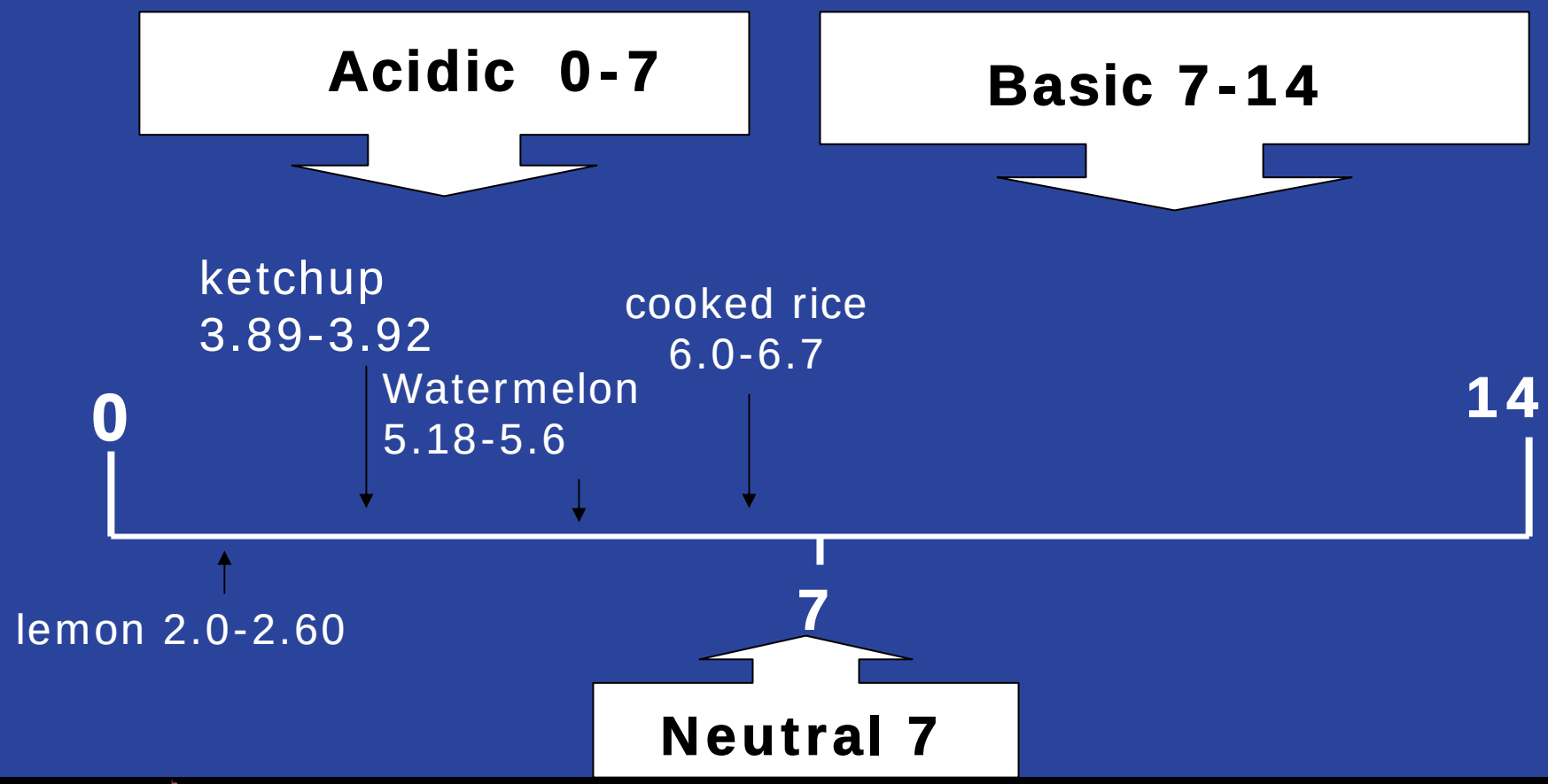
- Nutrients
- pH
- Time
- Temperature
- +/- Oxygen
- Water Activity

Potentially Hazardous Foods (Nutrients)

Oxygen

- Aerobic
- Anaerobic
- Facultative

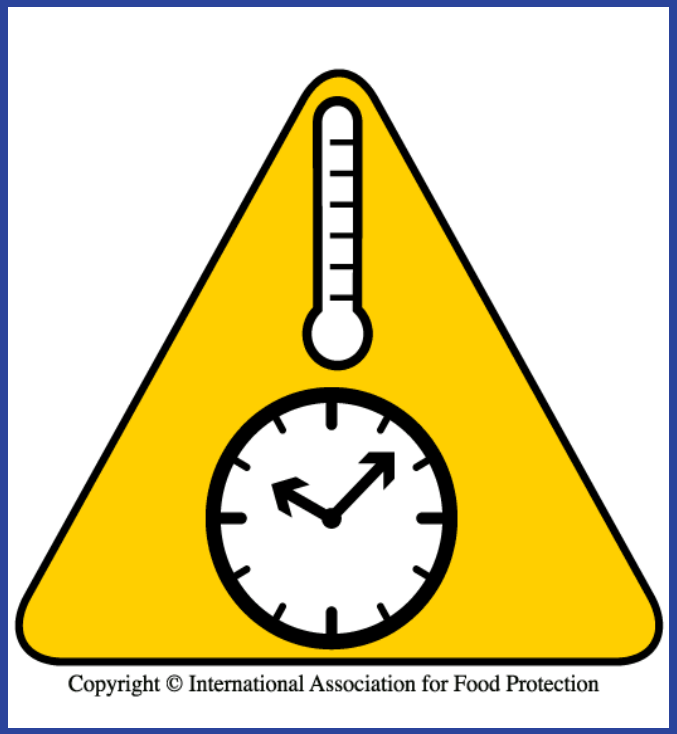
pH Scale and foods



Water Activity (a_w)

- Molecules available
- Can be affected by sugar and salt content
- <0.85 not a potentially hazardous food

Time and Temperature



- Temperature
  - "Danger Zone" – above 41ºF (5ºC) and below 140ºF (60ºC)
- Time
  - Max. of 4 hours if using time as public health control

Bacterial Spores

- Spores
  - Can survive cooking and freezing temperatures
  - Can survive disinfection
  - Contain genetic material

Toxins

- Few are destroyed by heat
  - Botulinum 80ºC (176ºF)
- Most are not destroyed by heat
  - Staphylococcus toxin
  - Seafood toxins
  - Plant toxins
  - Aflatoxins

Growth Factors and Pathogens

Pathogen	Temperature °C (ºF)	pH	Aw
Salmonella spp.	6.5-47 (43.7-116.6)	4.5-?	>0.95
Listeria monocytogenes	2-45 (35.6-113)	4.8-9.6	>0.95
Stapyhlococcus aureus	7-45 (44.6-113)	4.2-9.3	>0.86
Escherichia coli	2.5-45 (36.5-113)	4.6-9.5	>0.93
Campylobacter jejuni	25-42 (77-107.6)	5.5-8	NR
Clostridium perfringens	10-52 (50-125.6)	5.5-8	>0.93

pH and Pathogens

Food Items	pH
Apples	3.3-4.0
Tomatoes	3.5-4.9
Lemons	2.0-2.6
Mayonnaise	4.2-4.5
Rice	6.0-6.7
Chicken	6.5-6.7
Milk	6.4-6.8

Pathogen	pH
Bacillus cereus	4.9-9.3
Listeria monocytogenes	4.8-9.6
Staphylococcus aureus	4.2-9.3
Salmonella spp.	4.5-?
E. Coli	4.6-9.5

Control of Environment

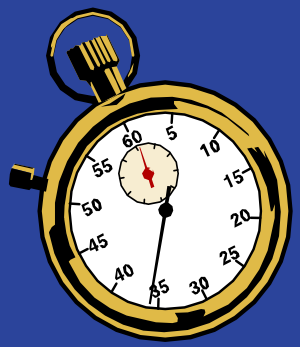
- Salt curing
- Acidifying
- Vacuum packaging
- Dehydrating
- Blast chilling/freezing

- Time
- Water activity
- pH
- Air
- Temperature

Match columns

What You Can Control and Measure Easily

- Temperature
  - Thermometer
- Time
  - Clock



Time and Temperature Control

- Cook foods rapidly.
- Cool foods rapidly.
- Re-heat food rapidly.

Resources and References

- www.cdc.gov
  - www.cdc.gov/nceh/vsp
- www.fda.gov
- www.usda.gov