



# Food Safety Training for Home-based Food Processors

## New Mexico State University



New Mexico Environment Department  
Environmental Health Division

# ***Module 2: Biological Hazards***

Learning objectives:

- Definitions
- Factors
- Growth phases
- Inhibitors
- Pathogens
- Controls



# ***Biological Hazards***

- Microorganisms:
  - ***Pathogens*** – foodborne pathogens cause foodborne disease
  - ***Spoilage organisms*** – cause food to deteriorate and develop unpleasant odors, tastes, and textures
  - ***Beneficial organisms*** – used in manufacture of certain foods (yogurt, vinegar, cheese, etc.)

# ***Define Terms***

- ***Spore formers*** – resistance to adverse conditions by developing a protective “shell”
- ***Toxin producer*** – form ‘poisons’ that damage host cells and tissues
- ***Infection*** – caused by consuming food contaminated with pathogens
- ***Intoxication*** – caused by consuming food contaminated with biological toxins (formed by bacteria) or chemical toxins (poisons)
- ***Toxin-mediated infection*** – caused by bacteria that grow in the body and form toxins

# ***Bacteria basics***

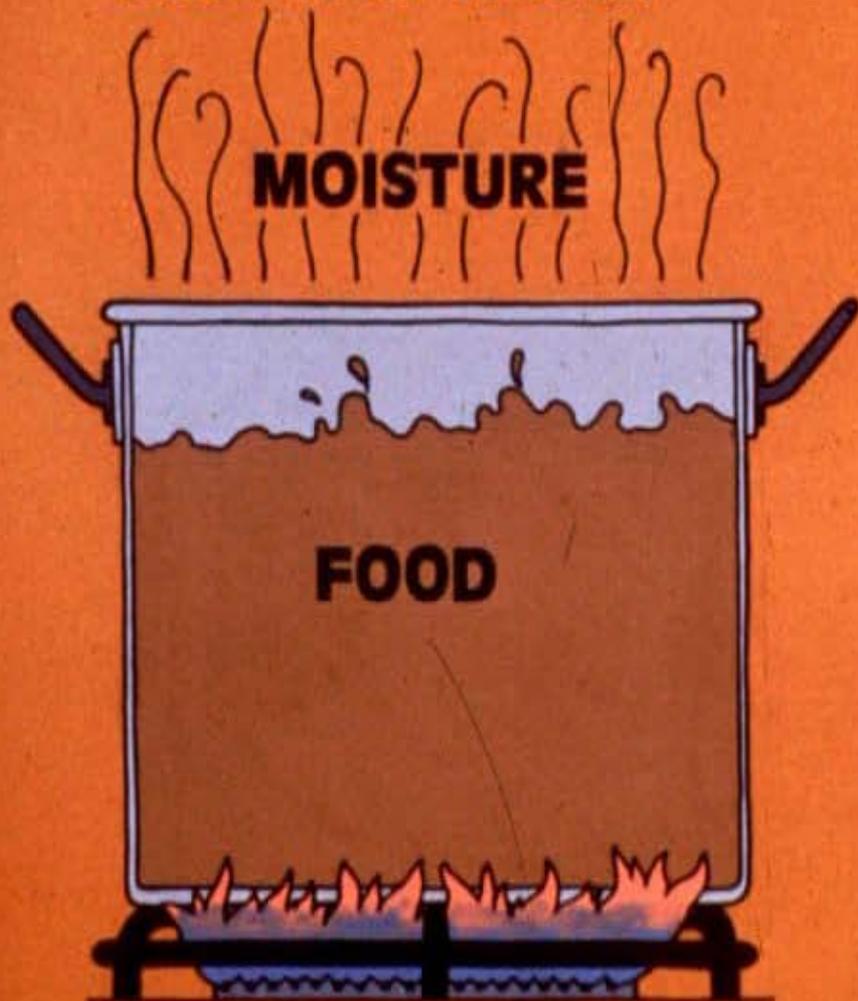
- Invisible to the naked eye
- Pathogenic bacteria only grow in Potentially Hazardous Food (PHF)
- Spore formers-survive cooking
- Toxin producing
- Toxins not necessarily destroyed by freezing or cooking
- Can cause infection, intoxication, or toxin-mediated infection

# ***Factors Influencing Bacterial Growth***

- ***Food***
- ***Acidity***
- ***Temperature***
- ***Time***
- ***Oxygen***
- ***Moisture***

**For growth, foodborne disease  
bacteria need:**

**MOISTURE**



**FOOD**

**TIME**



**WARMTH**

# ***Factors Influencing Bacterial Growth***

***Food:*** Bacteria have various food preferences. Those that cause FBI like the same kind of food we like

- ***Potentially Hazardous Food (PHF)*** – moist, protein rich, neutral or slightly acidic food that supports bacterial growth
- ***Examples:***
  - Meats & fish
  - Dairy products
  - Cooked legumes & starches

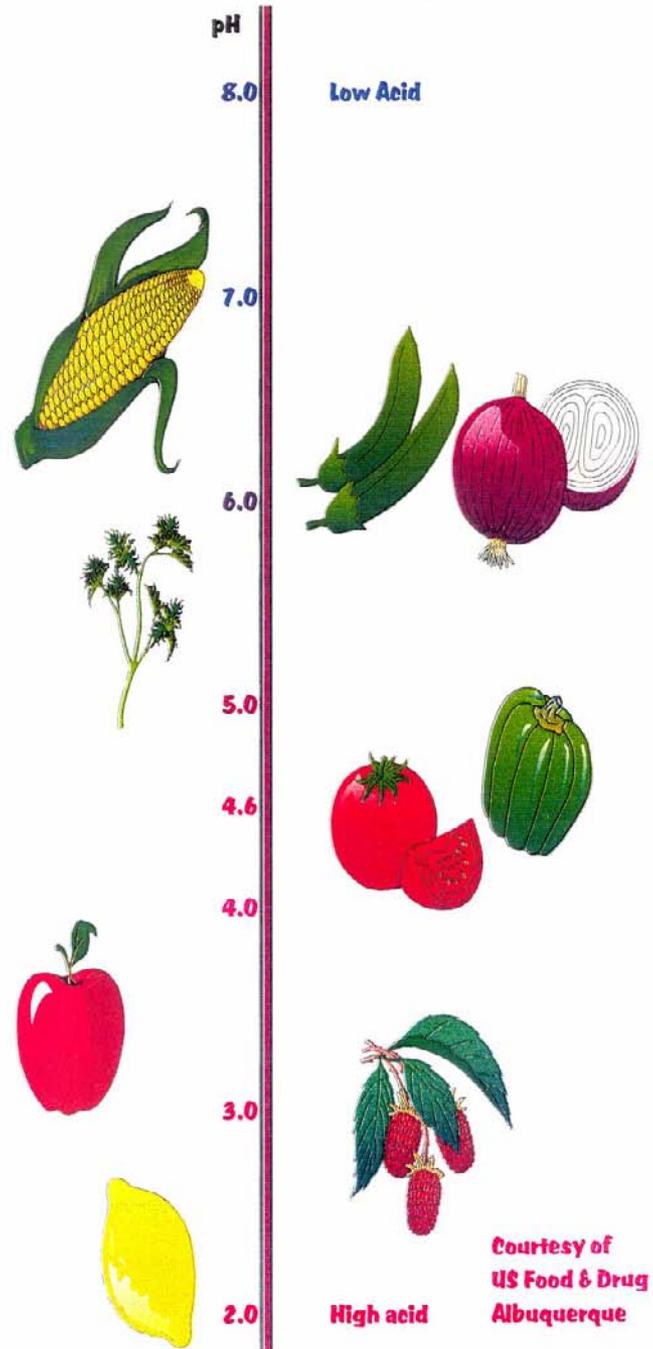
# ***Factors Influencing Bacterial Growth***

## ***Acidity***

- pH is a measure of acid  
(pH below 7)
- or alkali (pH above 7) in a product;  
pH 7 is neutral
- most bacteria that can cause  
foodborne illness grow best in foods  
that have pH values from 4.6-7.5

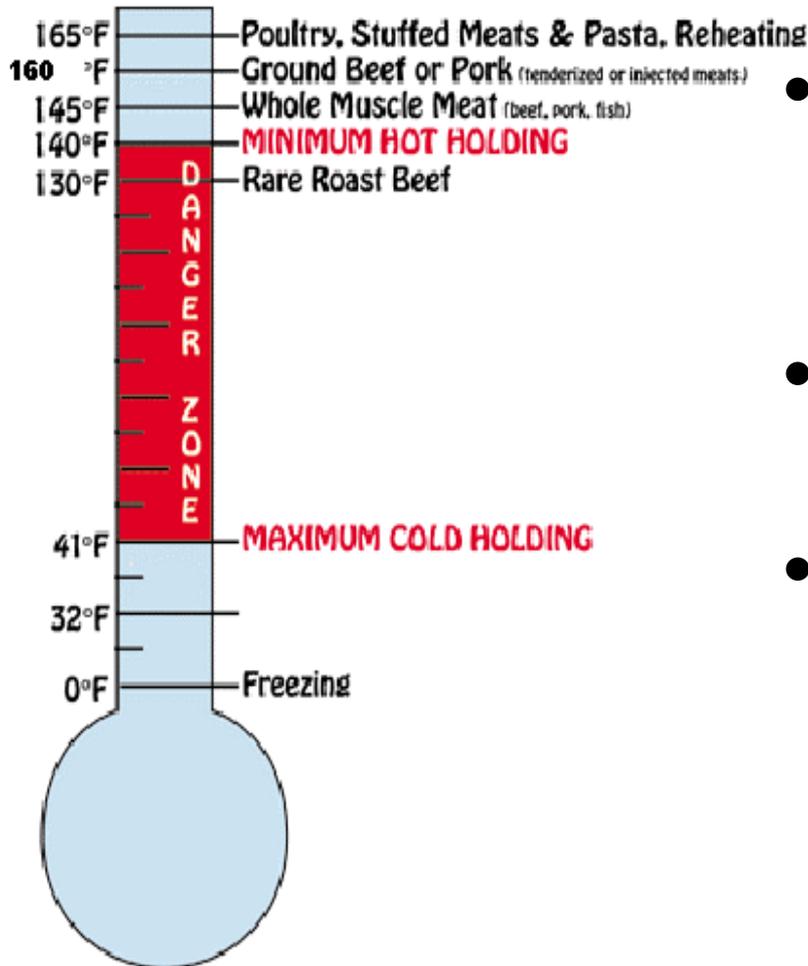
TABLE 1—The comparison of the acidity in pure water and representative foods at each pH value

pH Value	Degree of Acidity	
	Compared to Water	Example of Foods
0	10,000,000	
1	1,000,000	0.1 N Hydrochloric Acid
2	100,000	Limes
3	10,000	Grapefruit
4	1,000	Peaches
5	100	Carrots
6	10	Beans
7	0	Olives



Courtesy of  
US Food & Drug  
Albuquerque

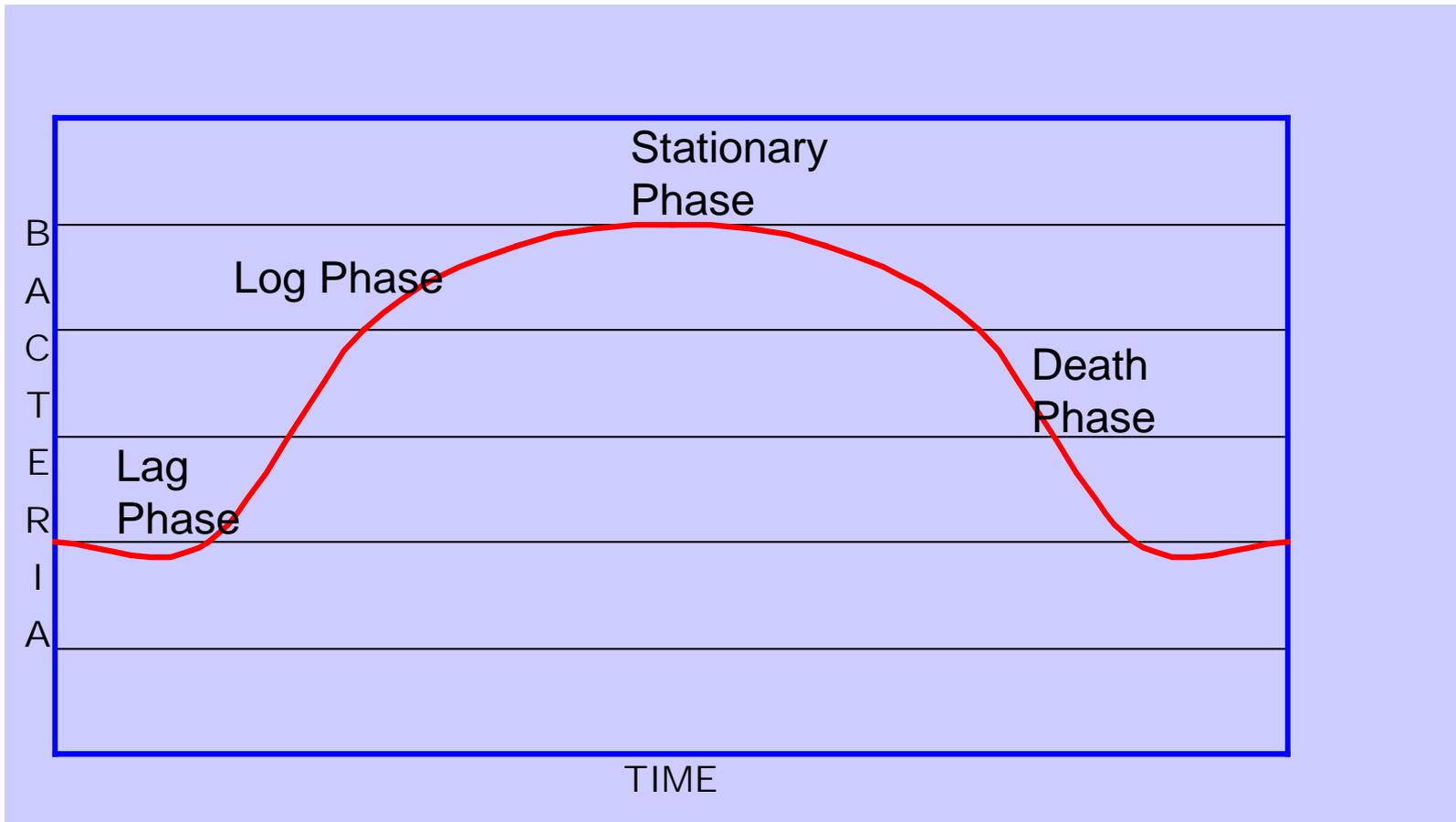
# Factors Influencing Bacterial Growth



- Temperature – is the most widely used method of controlling bacterial growth
- Between 40°F and 140°F bacteria can multiply quickly
- Keep food cold (40°F or less) or keep foods hot (140°F or more) to be safe

# ***Bacterial Growth Phases***

**Time: Generation times can be around 20 minutes; growth is logarithmic**



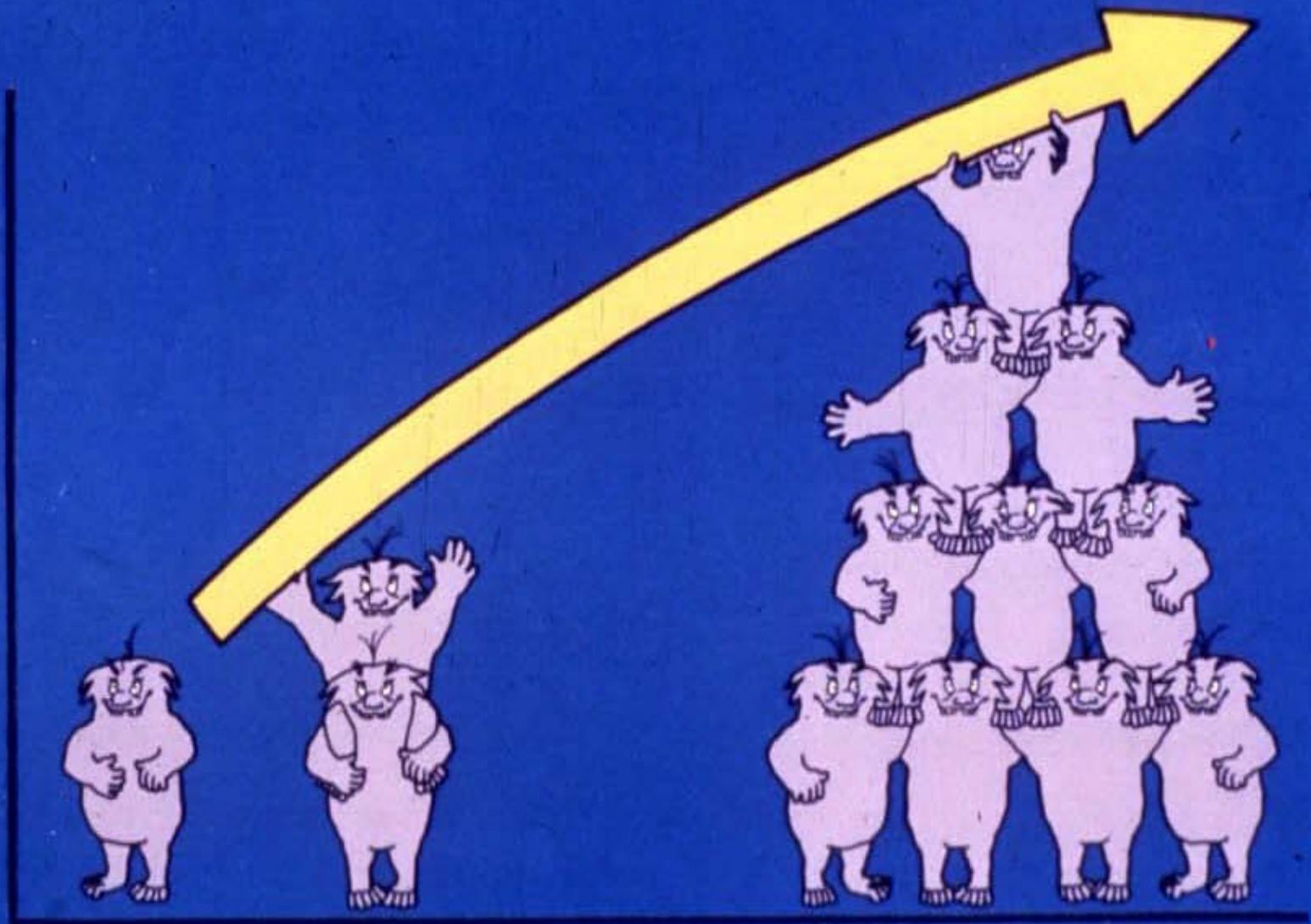
# ***Logarithmic Growth Rate of Bacteria***

Time	Number of Bacteria	Time	Number of bacteria
Start	500	2 hr 20 min	64,000
20 min	1000	2 hr 40 min	128,000
40 min	2000	3 hrs	256,000
60 min	4000	3 hr 20 min	512,000
1 hr 20 min	8000	3 hr 40 min	1,024,000
1 hr 40 min	16000	4 hrs	2,048,000
2 hrs	32000	4 hr 20 min	4,096,000

Food is allowed to be in the Temperature Danger Zone for no more that 4 hrs.  
The time is accumulative.

# Bacterial Growth Curve

NUMBERS OF BACTERIA



LENGTH OF TIME



300,000  
offspring  
in one hour

# ***Factors Influencing Bacterial Growth***

## ***Oxygen – atmospheric conditions***

- *Aerobes* – require oxygen to grow
- *Anaerobes* – grow only in the absence of oxygen
- *Facultative anaerobes* – grow with or without oxygen present

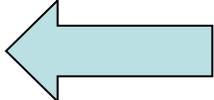
# ***Factors Influencing Bacterial Growth***

## ***Moisture***

- There must be adequate moisture for bacteria to grow
- The amount of moisture needed is defined by the term water activity ( $a_w$ ).
- $A_w$  greater than 0.85 is needed for FBI causing bacteria to grow (well).

# Water activity

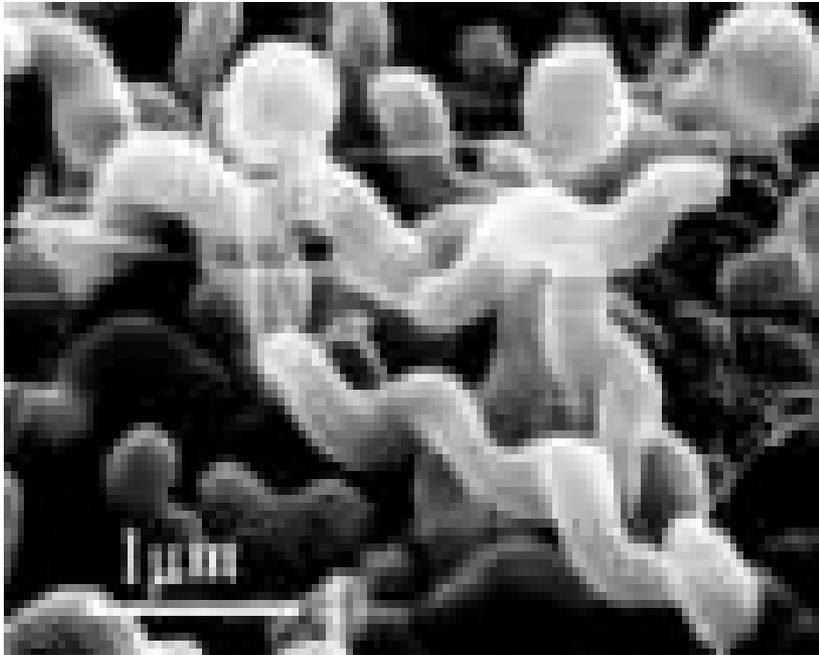
Food Product	water activity $a_w$
Fresh meat of fish	0.99
Bread	0.95
Cheddar cheese	0.85
Jams and jellies	0.80
Dried fruit	0.60
Biscuits	0.30
Instant coffee	0.20



# ***Inhibitory Substances***

- Inhibitory substances from bacteria, as a natural ingredient in food, or added during the manufacture may slow down, stop, or inhibit growth of some bacteria.
- Examples:
  - Salt
  - Sugar
  - Preservatives

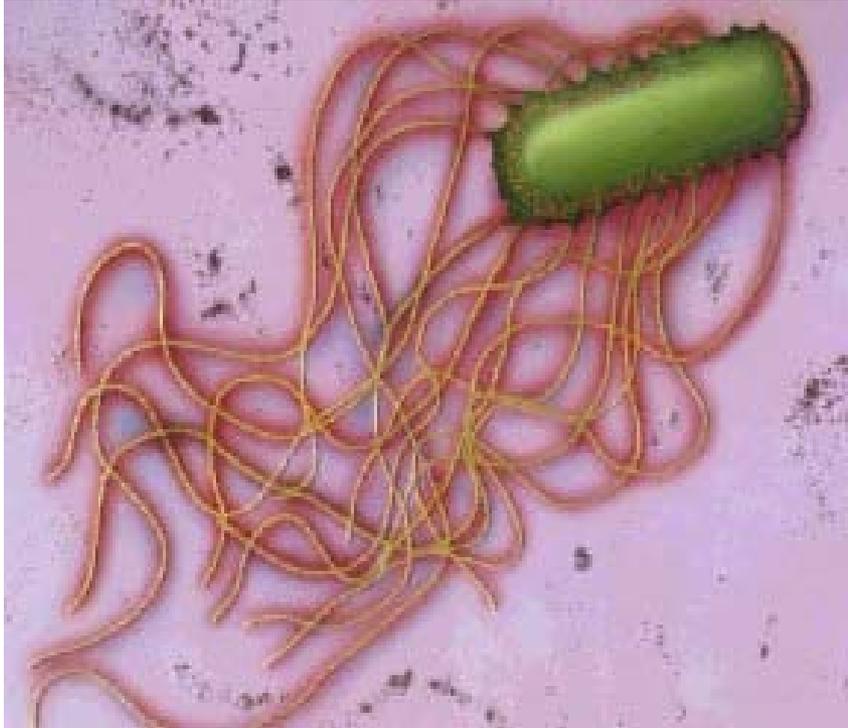
# ***Common Foodborne Bacteria***



## ***Campylobacter***

- 400 to 500 bacteria can cause illness
- Found in raw chicken raw milk and non chlorinated water
- 2 to 4 million + cases per year

# ***Common Foodborne Bacteria***



## ***Salmonella***

- Only 15 to 20 cell to cause illness
- Found in meat, poultry, eggs and dairy products
- 2 to 4 million cases per year

# ***Common Foodborne Bacteria***



## ***E. coli 0157:H7***

- As few as 10 organisms can cause illness
- Found in uncooked meat, alfalfa sprouts, poultry, unpasteurized fruit juices, and lettuce
- 73,000 cases per year

# ***Controlling Bacteria***

- ***Good Personal hygiene***
  - do not handle food while ill
  - follow good hand washing procedures
- ***Prevent cross-contamination***
  - proper food storage
  - follow proper cleaning and sanitizing procedures
- ***Time-temperature control***
  - Cook to proper temperature
  - Hold at proper temperature

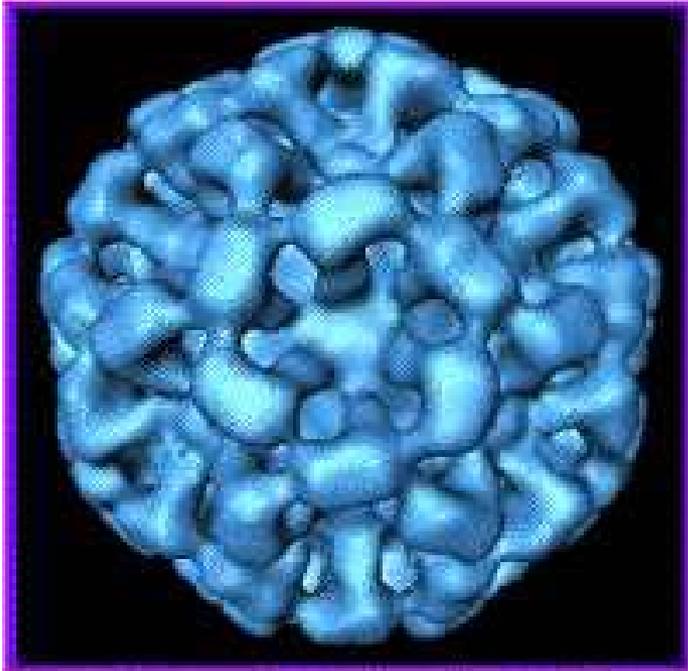
# ***Virus basics***

- Invisible to the naked eye  
(smaller than bacteria)
- Do not grow in food
- Food is a common vehicle into our bodies
- Cause most foodborne illnesses in US
- Cause foodborne infection (not intoxication)
- Can contaminate all types of food

# ***Controlling viruses***

- Prevent the contamination of foods with viruses by
  - preventing ill food handlers from handling food;
  - following good hand washing practices;
  - using only food from approved and safe sources

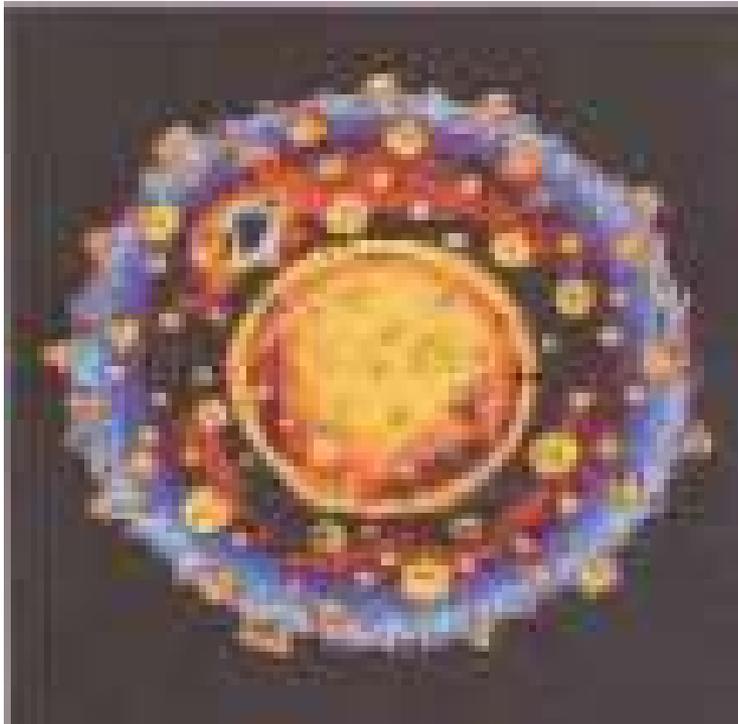
# ***Common Foodborne Virus***



## ***Norovirus***

- Only 15 to 20 virus particles to cause illness
- Found in meat, poultry, eggs and dairy products
- 2 to 4 million cases per year

# ***Common Foodborne Virus***



## ***Hepatitis A***

- 10 to 100 virus particles can cause illness
- Found in water, ice, shellfish and salads or anything cleaned with contaminated water
- 27 thousand cases per year

# *Parasite Basics*

- Most are not visible to the naked eye
- Do not grow in food
- Found naturally in animals
  - pigs
  - fish
  - cats/dogs
  - rodents
- Cause foodborne infection, not foodborne intoxication

# ***Common Foodborne Parasites***

- *Anisakis simplex*
- *Cryptosporidium parvum*
- *Cyclospora cayetanensis*
- *Giardia duodenalis*
- *Toxoplasma gondii*
- *Trichinella spiralis*

# ***Controlling Parasites in Food***

- Food from approved and safe sources
- Cook to proper temperature
- Properly freeze for parasite destruction
- Follow good hand-washing procedures
- Use safe water sources

# ***Module 2: Review***

Learning objectives:

- Definitions
- Factors- FATTOM
- Growth phases- four
- Inhibitors- ingredients
- Pathogens- 3-4 categories
- Controls- protect food

