



EU-India Capacity Building Initiative for Trade Development in India (CITD)



Train the Trainers in Food Safety and Nutrition

**Need for Food Safety
Invisible World of Microorganisms**

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- Need for food safety
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- Mode of Spread of Food Borne Diseases
- Microorganisms
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- Time Temperature Principle

Food Safety

"What You
Need to Know"

Need for Food Safety

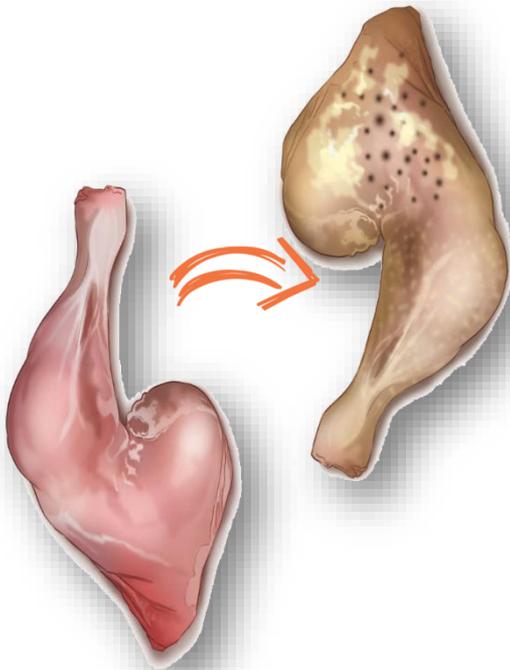


**FOOD
SAFETY**



Need For Food Safety

- Food is perishable.
- If unhygienically handled it spoils and pathogens grow.
- Infections are caused by different microorganisms which we cannot see.
- Frequent infections lead to malnutrition and a lowered resistance to infection.
- Malnourished children are more prone to catching infections.

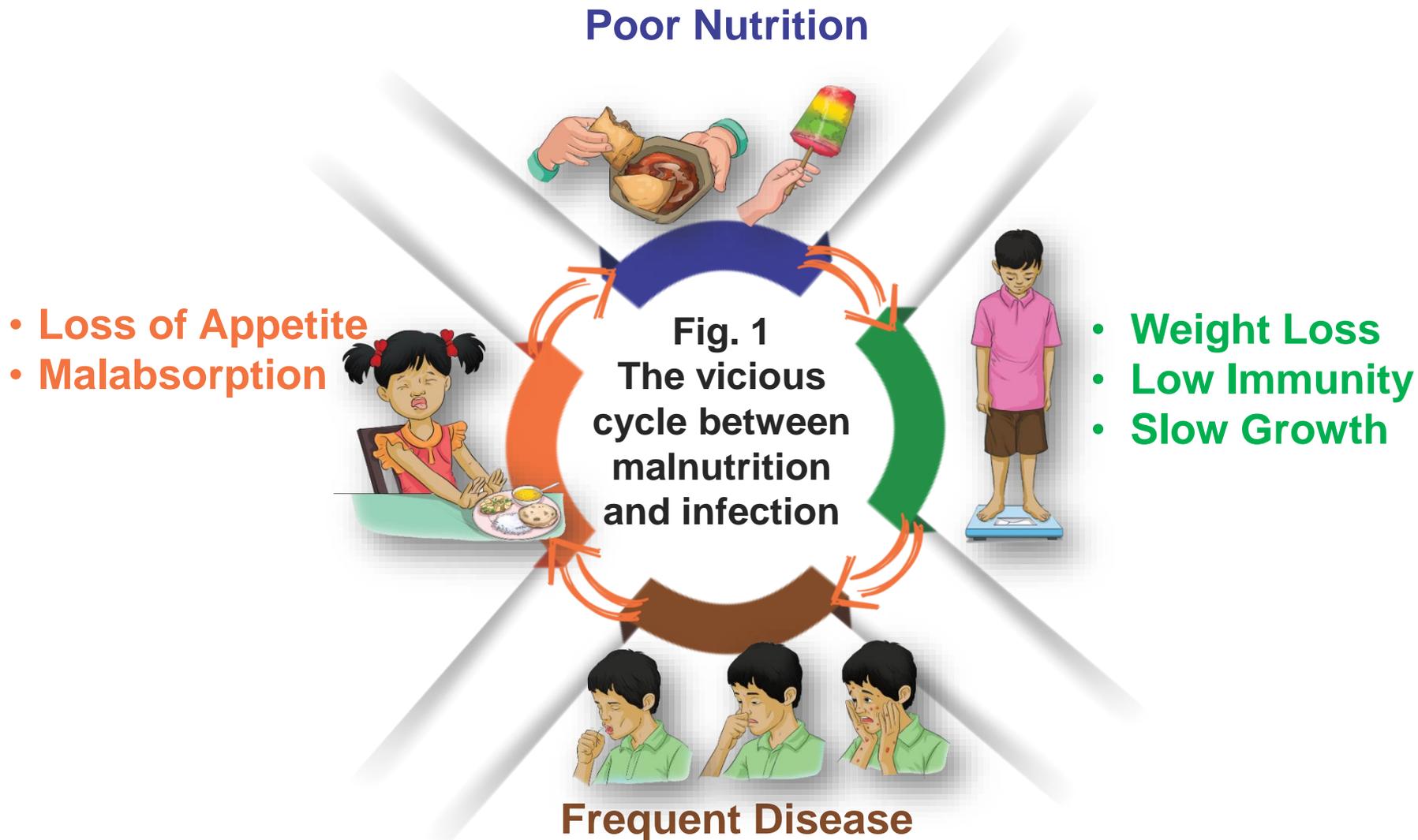


Effect of Poor Hygiene On Health

- Children are constantly exposed to common infections like colds, coughs, influenza and diarrhea.
- Ill children have a poor appetite and nutrients are malabsorbed.
- This affects overall growth and development.



Malnutrition and Infection



Why do we need a Food Safety Programme?

- Food handlers need to understand the relationship between malnutrition and infection and try to **break the vicious cycle of malnutrition and infection.**
- Food not only causes **infection** but **spoils** if not stored and handled properly.
- **Spoilage** makes food unfit for consumption and **leads to wastage.**
- If a **good nutritional status** is to be achieved, it is necessary that children are **served safe and wholesome food in a clean environment.**



What can Schools Do?

Take steps to ensure that

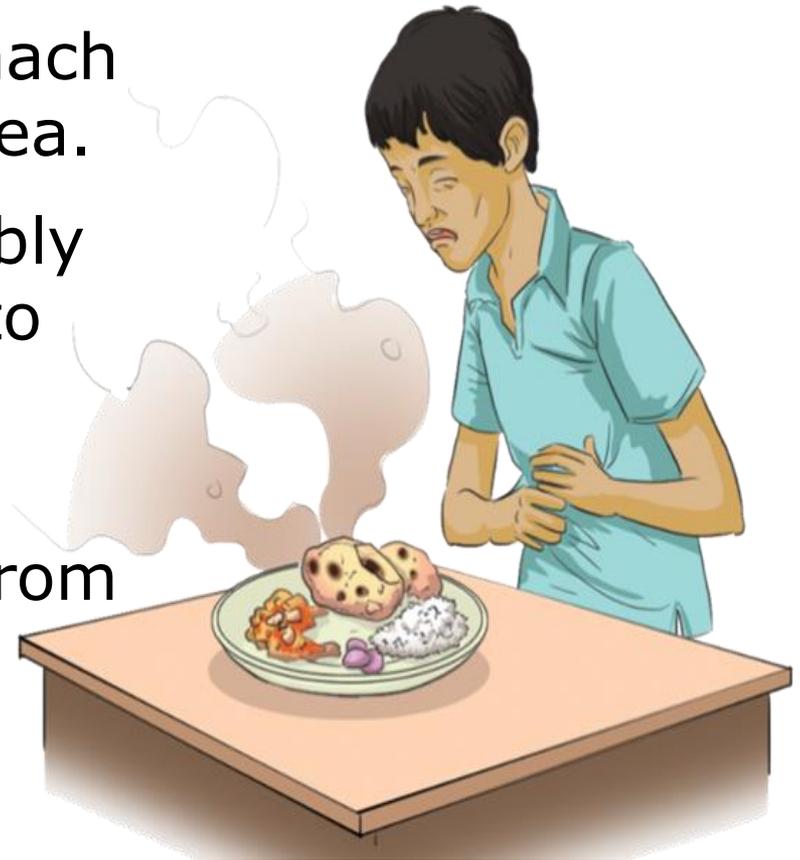
- **food hygiene, personal hygiene and hygiene of the classrooms and surroundings is maintained.**
- Teachers **encourage children to bring wholesome packed meals.**
- Food served in schools is **healthy and palatable.**
- **Physical activity** for overall growth and development of the child is **encouraged.**
- Children are **Safe Food Ambassadors to spread the message on cleanliness, care and good food habits** taught in school among their parents, friends and the community.



Malnutrition increases the risk of infections and infections can, in turn, lead to malnutrition. Hygiene and Nutrition go hand in hand.

Food Borne Diseases

- Sometimes the food you eat makes you sick.
- You may have nausea, stomach cramps, vomiting or diarrhoea.
- The food you ate was probably contaminated or spoiled due to unhygienic handling, poor storage etc.
- You are probably suffering from a food borne disease



What are Food Borne Diseases?

Infections or diseases caused by contaminated food and beverages are called **Food Borne Diseases**.

They include

- food poisoning
- food infections and
- food allergies

The causative agent in **food poisoning** and **food infections** are **microorganisms**.



ACTIVITY 1

Divide yourselves into 5 groups (Group 1 – 5). Each group should fill in the blanks.

1. Pathogens or disease causing agents are spread to food through the 5 F's. Name them.

- F

2. Discuss amongst your group members as to how microbes contaminate our food.

.....
.....



The 5 F's Which Are Responsible for Spread of Disease

Food

Contaminated food and water infected by food handler or from the farm, diseased animals and their products

Fingers

Unwashed hands and dirty fingernails

Faeces

Sewage, contaminated food, water, and unwashed hands after using the toilet

Fomites

Unclean utensils, equipment, door knobs, taps and towels

Flies and Pests

Houseflies, cockroaches, rats and pets

The **5F's** need to be controlled to keep food spoilage and **Food Borne Diseases** away.

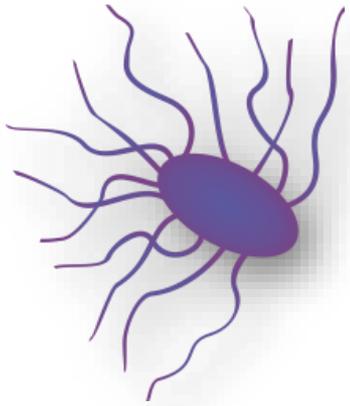


Chart 1: The 5 'F's responsible for spreading Food Borne Diseases.

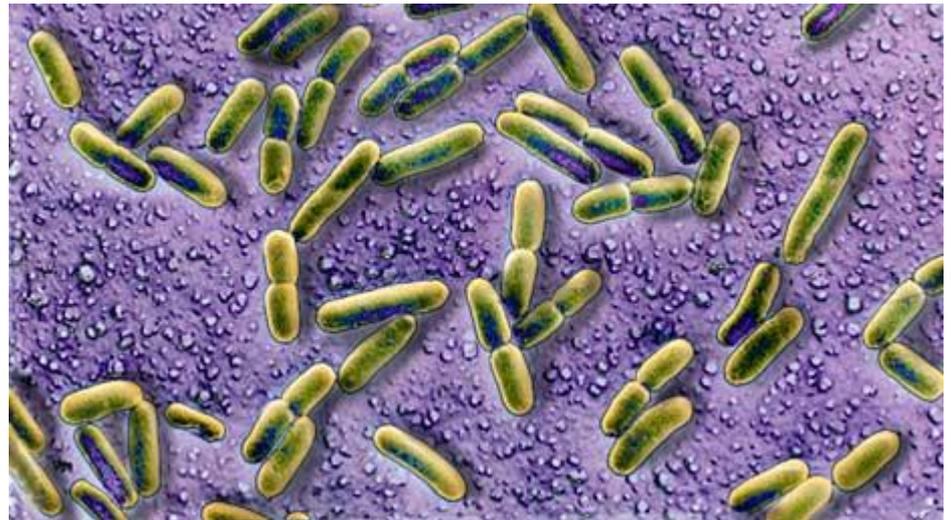
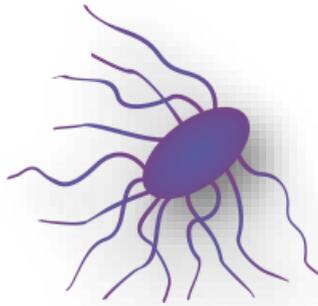


The 5F's need to be controlled to keep food spoilage and Food Borne Diseases away.





The Invisible World of Microorganisms



What are Microorganisms?

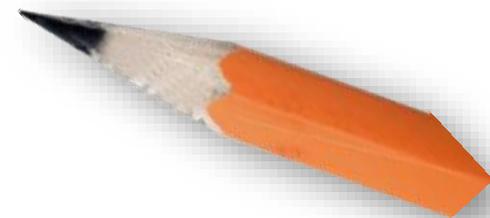
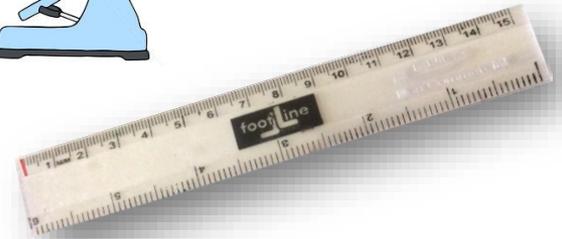
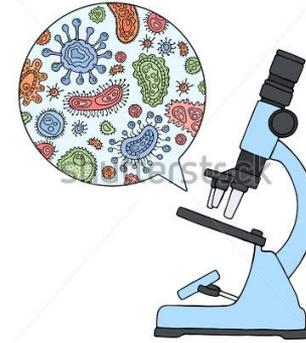
Infections are caused by different microorganisms which are found everywhere – air, water, sewage, soil, plants, animals, humans and their food.

They are very small, we cannot see them unless we use a microscope.

Microorganisms may be unicellular (made up of only 1 cell) or multi-cellular and are of different shapes and sizes.

They are measured in microns. One micron or 1/1000th of a millimeter (mm).

They are so small that it would at least take 1000 bacteria to cover the point of a pencil.



Are all microbes harmful?

- All microorganisms are not harmful.
- Some are useful and we use them to add flavor and texture to our food.
- Some microorganisms are harmful causing diseases
- Others spoil and rot our food like mold growth on bread and yeast fermenting fruit juice.



Which Microorganisms are of significance to us?

Five groups of microorganisms are of significance to us.

- Viruses
- Bacteria
- Fungi - a. Yeasts and b. Molds
- Algae
- Parasites a. protozoa and b. eggs and cysts of worms



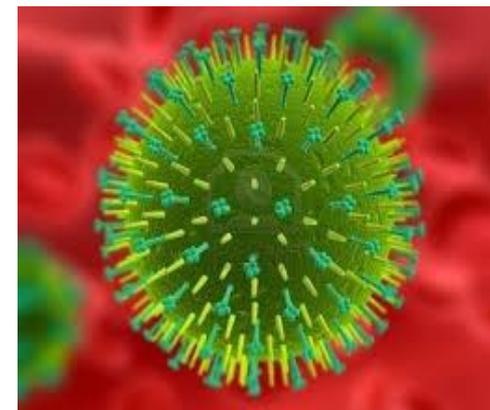
Viruses

- Smallest of all microorganisms.
- Strict parasites and grow only in living cells.
- Found in sewage contaminated food and water [cause poliomyelitis and infectious hepatitis (jaundice)].
- Air borne viruses can cause common cold, influenza, mumps, measles and chicken pox.

Hepatitis A virus



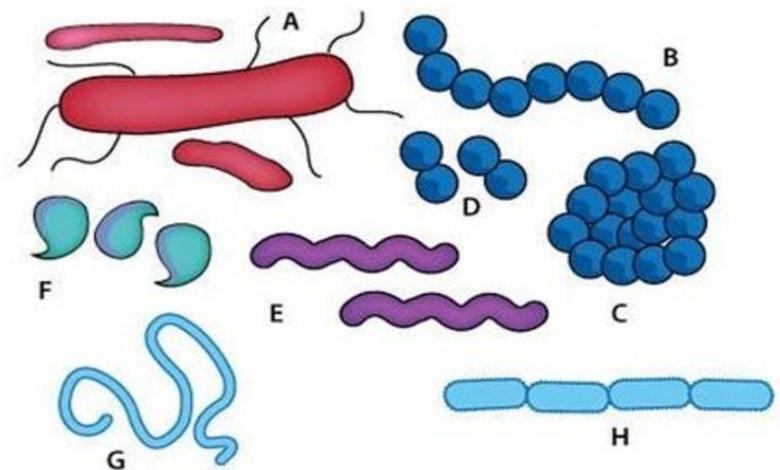
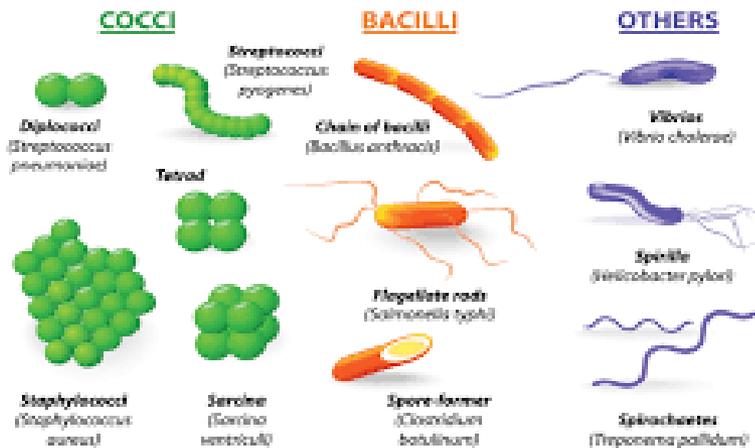
Influenza virus



Bacteria

- Bacteria are found everywhere.
- Unicellular and are of different shapes and sizes, generally rod shaped or spherical.
- Average size of bacteria is one micron or 1/1000th of a millimeter(mm).

TYPES OF BACTERIA

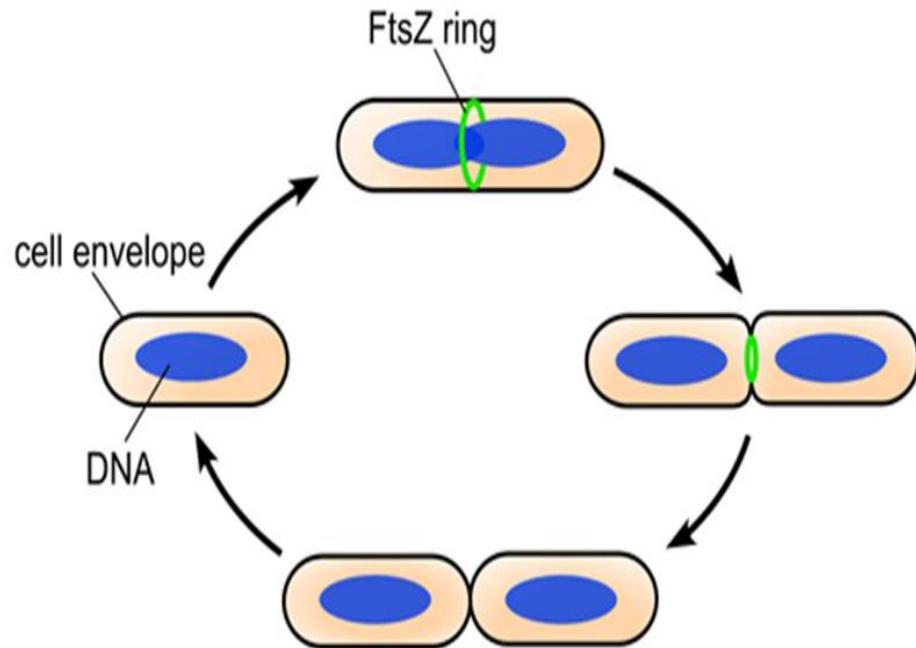


How do Microorganisms Grow?

When microorganisms grow they multiply and increase in number.

Bacteria grow by a process called binary fission by dividing into two every 20 minutes under favorable conditions.

BINARY FISSION:



FAVORABLE CONDITIONS

- Nutritious food
- Presence of moisture/water
- Warm temperature and
- Adequate Time

How do Microorganisms Survive?

When conditions for growth are unfavourable some bacteria form a resistant structure within the cell called an endospore or spore.

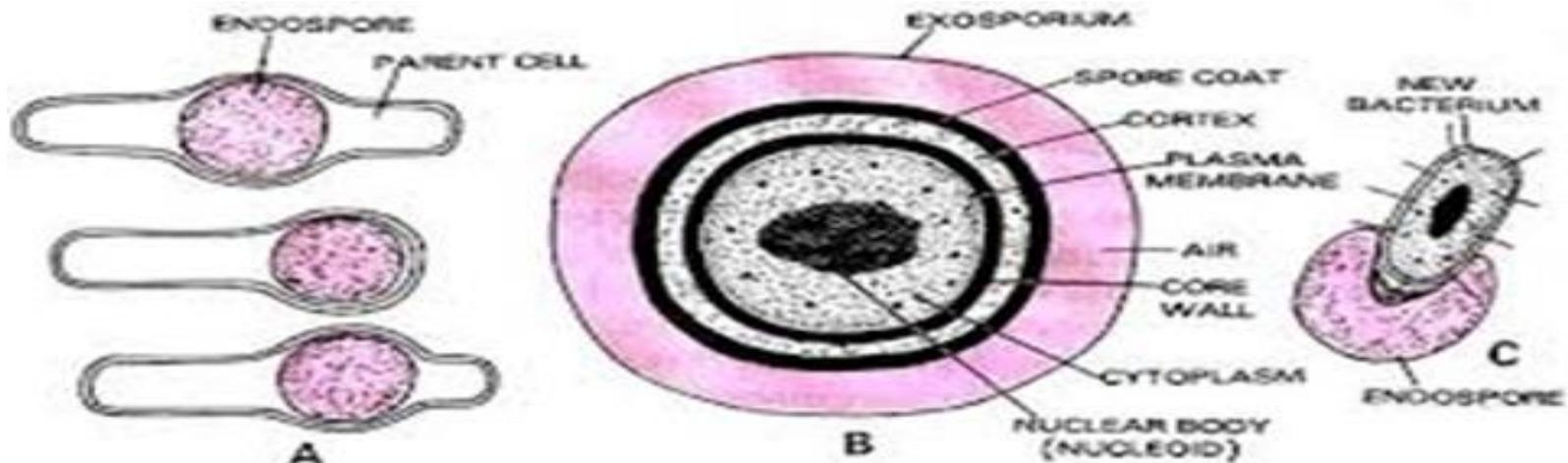


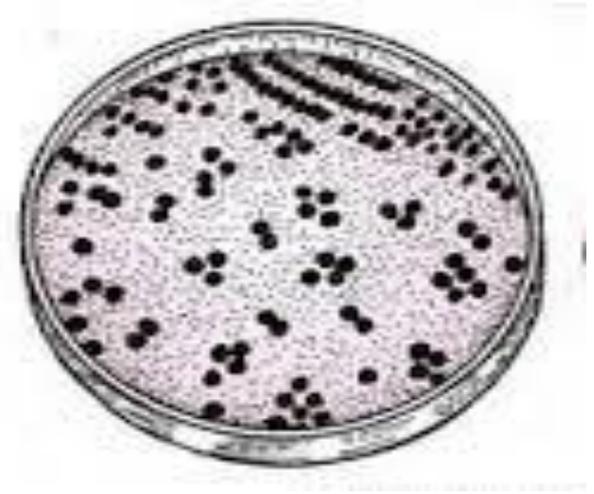
Fig. 2.12. Endospores. A, types of endospores according to their position in parent cells. B, structure of an endospore. C, germination of endospore.

Unfavourable conditions - high temperature, desiccation and some chemicals.

When conditions are favourable, spores germinate into vegetative cells and multiply very rapidly

Bacteria

- When they multiply on a suitable medium, visible colonies appear on the plate within 24 hours.
- Each colony contains lakhs and crores of bacteria which appear as dots on the plate.
- Each colony seen, may have formed from a single microorganism



Useful and harmful Bacteria

- Bacteria are both useful and harmful.
- Useful bacteria - species of Lactobacilli and Streptococci ferment lactose in milk to lactic acid and. Used to prepare curds, yoghurt, and cheese.
- Other bacteria leaven idli, dosa and dhokla batters, while some oxidize ethyl alcohol to acetic acid for making vinegar.
- Many bacteria cause diseases like cholera and typhoid fever.
- Most food infections and food poisonings are caused by bacteria.
- They can also spoil the colour and flavor of our food.

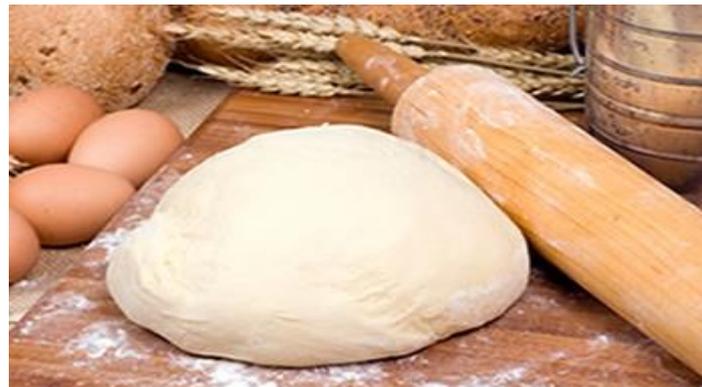


Fungi

This group includes the **yeasts and molds.**

Yeasts

- Unicellular, larger in size than bacteria.
- Ferment sugar and starch to ethyl alcohol and CO₂. Used to make bread and alcoholic beverages.
- Rich in B-complex vitamins.
- Grow on the surface of jams and pickles and spoil them i.e. they are osmophilic.



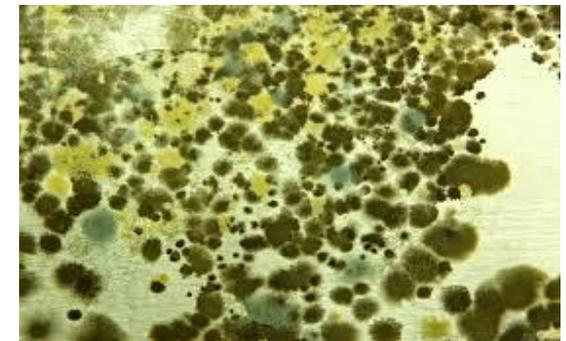
Molds

Molds

- Multi-cellular microorganisms several mm in length.
- Saprophytes - grow on the surface of dead organic matter and food with low moisture content.
- Growth is cottony, dry, powdery velvety or slimy, with colors ranging from white, yellow, blue, green or black.
- Spoil bread, jam, cheese and pickles, rot fresh fruits and vegetables.
- Grow on damp groundnuts and grains producing toxins in them.



wiseGEEK



Useful Molds



- Edible mushrooms are molds and are rich in proteins, vitamins and minerals.
- Used to ripen cheese and make soya sauce.
- Produce life saving antibiotics like penicillin.



Algae and Parasites

Algae

- Found in water
- Both unicellular and multi-cellular.
- Useful in water purification and sewage treatment plants.
- Used to manufacture food additives to prevent ice-crystals in ice-creams.



Parasites

- Include both protozoa and cysts of parasitic worms commonly found in the intestine.
- Amoebic dysentery or amoebiasis, a common illness in our country is caused by sewage contamination of food or water.



Parasites

- Trichinosis and tape worm infestation is caused through consumption of diseased pork.
- Eggs of round worm, thread worm and giardia are transmitted through sewage contaminated soil, water and food; and through the faecal-oral route (improperly washed hands after visiting the toilet).

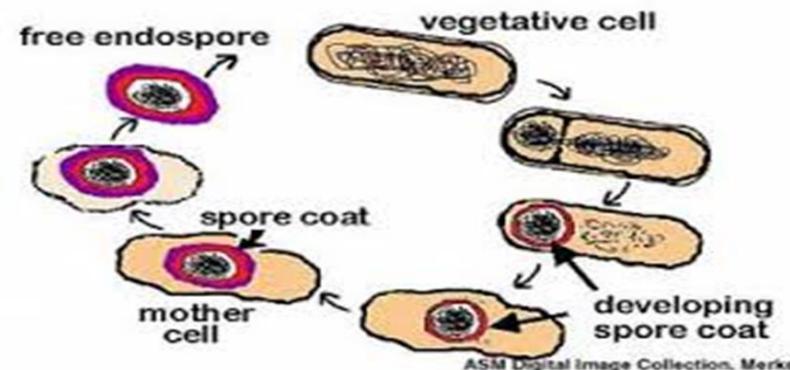
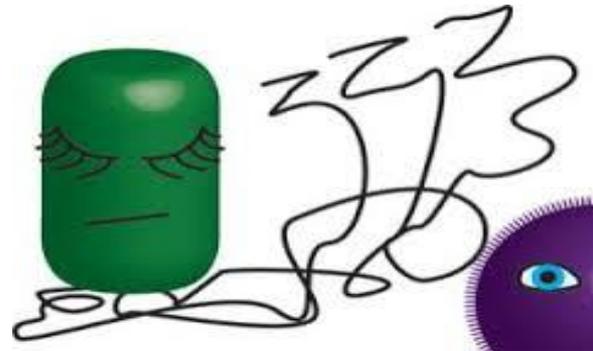


Basic Growth Requirements of Microorganisms

- **FOOD-** Microorganisms use our food as a source of nutrients for their growth.
 - ❑ Grow rapidly in 'High Risk' foods like milk, meat, poultry, and leftover moist cooked food if other conditions are favorable.
- **MOISTURE-** Microorganisms need moisture for their growth.
 - ❑ If moisture is removed from food by drying or dehydration, they will not spoil like papads and dried beans.
 - ❑ Growth of microorganisms depends on available moisture in food i.e. water which is not bound to sugar or salt.

Basic Growth Requirements of Microorganisms

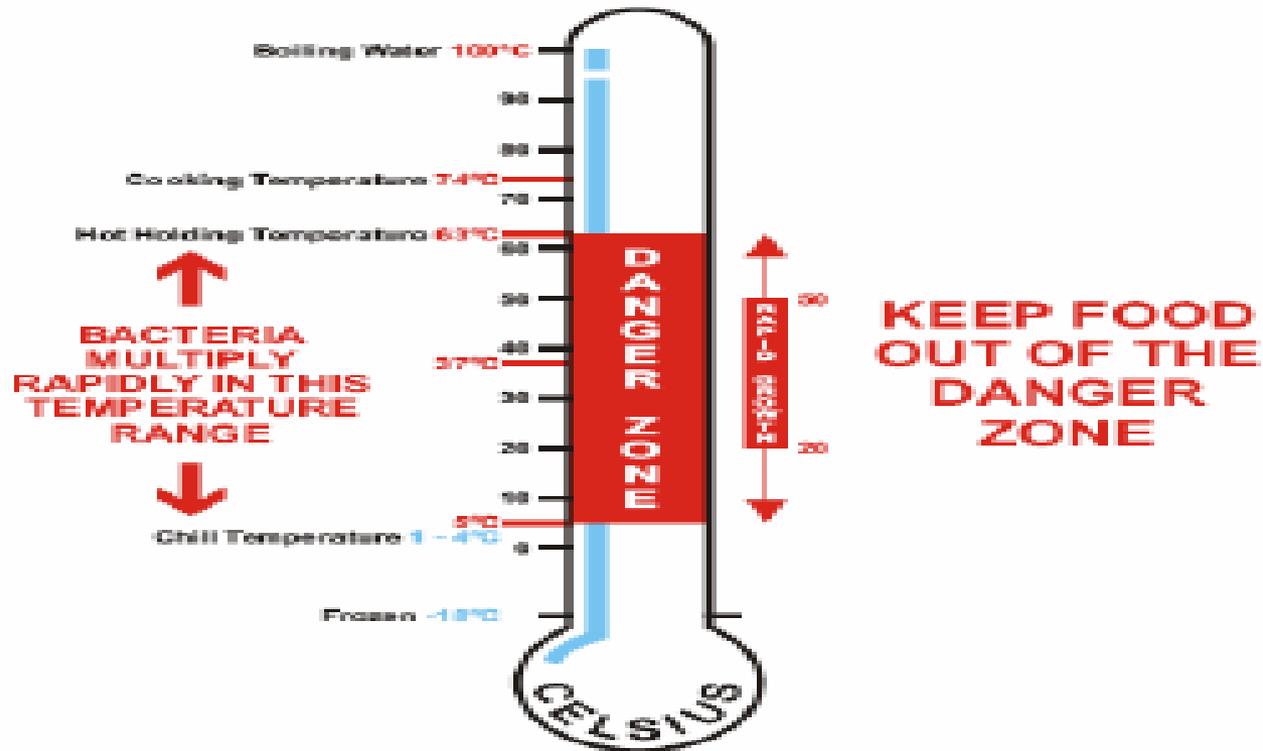
- **TEMPERATURE** - Grow in the temperature range of 5 °C and 63 °C called 'Danger Zone'.
 - ❑ Multiplication is maximum between 15 °C and 49 °C.
 - ❑ Die at temperatures above 63 °C if heated for several minutes.
 - ❑ Become dormant when food is refrigerated or frozen.
 - ❑ Cooking does not destroy all microorganisms.
 - ❑ Some pathogenic microorganisms or their spores remain in food. Spores germinate when conditions are favourable.



ASM Digital Image Collection, Merkel

The Danger Zone

Temperature Control



KEEP HOT FOOD HOT

KEEP COLD FOOD COLD



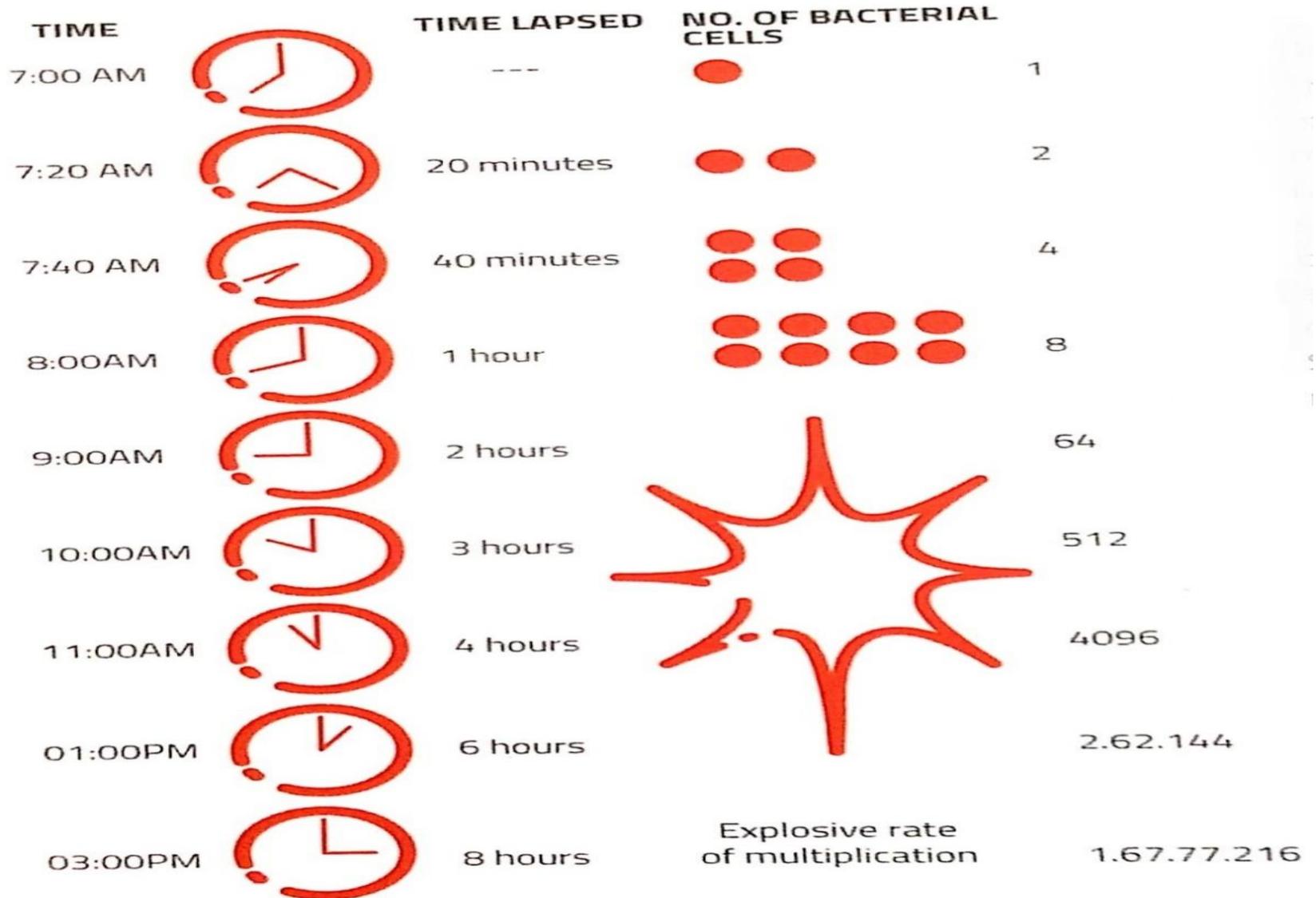
Basic Growth Requirements of Microorganisms

TIME - Microorganisms need time to grow to numbers large enough to spoil food.

- ❑ When conditions are favorable bacteria multiply by binary fission.
- ❑ One bacteria divides into two every 20 minutes.



Chart 2: Bacterial Growth



Basic Growth Requirements of Microorganisms

- **pH-** Most grow best at neutral pH.
 - ❑ Molds and yeast grow in an acidic pH of 4, while bacteria do not grow in acidic foods.
 - ❑ Acids such as acetic acid and citric acid are added to food to preserve it by controlling microbial growth.
- **OSMOTIC PRESSURE-** Bacteria cannot grow in high concentrations of sugar and salt like jam and pickle.
 - ❑ Molds and yeasts can grow at high osmotic pressures or high concentrations of sugar and salt and spoil foods.
- **OXYGEN-** Just like humans, animals and green plants, most microorganisms need oxygen for growth.
 - ❑ However, anaerobic microorganisms do not need oxygen for growth and may die in the presence of oxygen.



How can we control Microbial Growth?

- **Controlling Temperature**
 1. **Low temperatures** – In the refrigerator and freezer
 2. **High Temperatures** – During cooking. Spores may survive normal cooking temperatures.
- **Removing Oxygen** In vacuum packed and canned food. Anaerobic bacteria if present, can grow such foods.
- **Adding Chemical Preservatives** – To preserves like tomato sauce and fruit based squashes in permissible amounts.
- **Reducing the Moisture Content** – In evaporated and dehydrated foods making water unavailable to microorganisms.
- **Exposure to Ultraviolet Rays** – Sunlight and ultraviolet lamps are useful in sterilizing the surface of food and equipment.

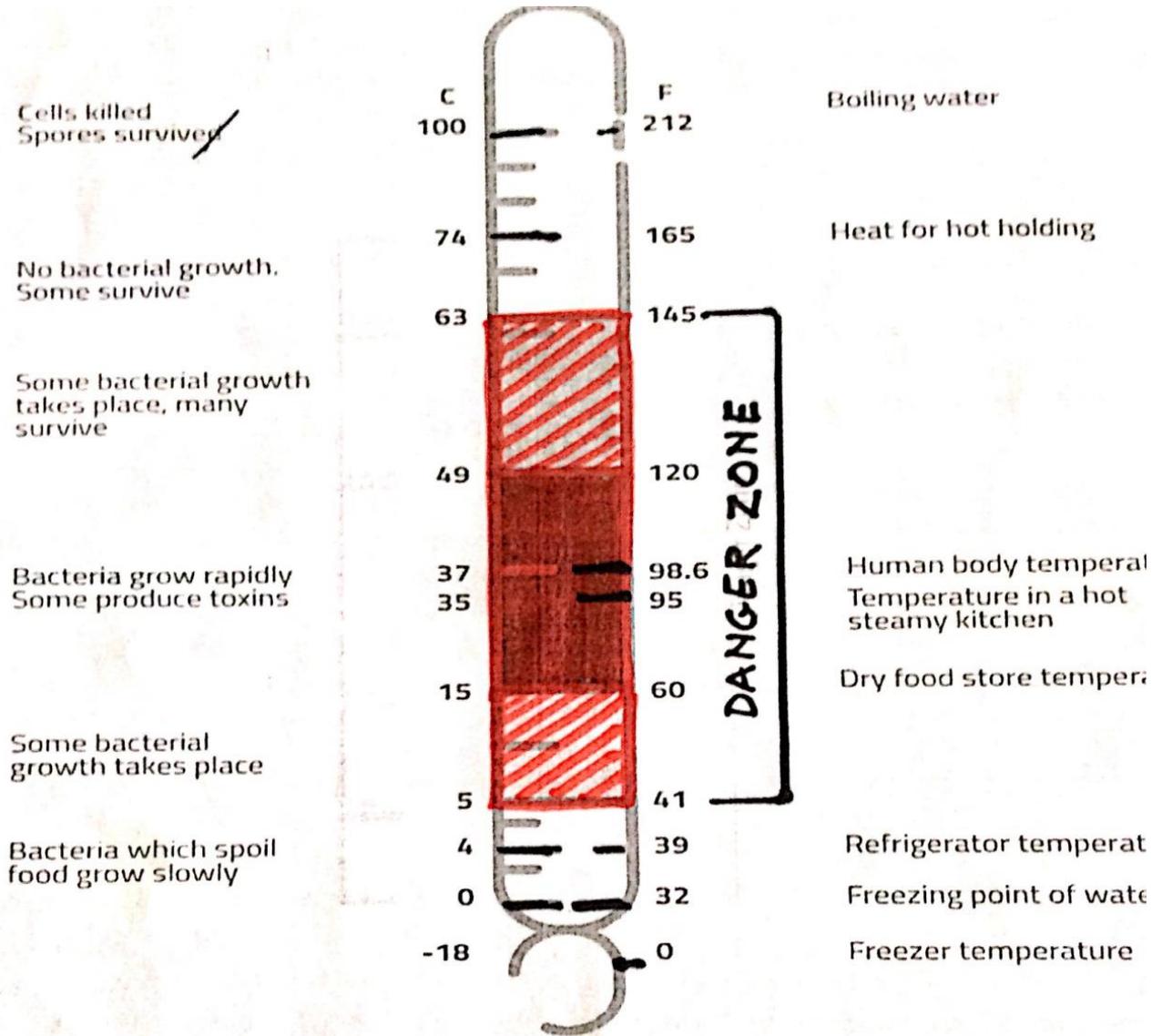


Why food is kept out of the Danger Zone?



- Microorganisms multiply over a wide range of temperature.
- The temperature range of 5 °C and 63 °C (41 °F to 145 °F) is called the DANGER ZONE.
- Microorganisms grow very fast within this range.
- The temperature in our classroom, in the kitchen and in our body is also within this range.
- Since microorganisms are present everywhere, and food can get easily contaminated, the time and temperature for which food remains in this zone needs to be controlled.

Effect of temperature on Microbial Growth



Controlling Time and Temperature

- Bacteria cannot grow fast if conditions for growth are unfavourable.
- Microbial growth can be controlled by controlling time and temperature.
- This can be explained by a simple activity like setting curd. Curd is made from liquid milk by action of bacteria.
 - A teaspoonful of curds contains millions of useful bacteria.
 - Milk is a nutritious food containing adequate moisture.
 - If given favorable temperature and time one teaspoonful of curds can become 1 kg curds.

Message

Microbes are present everywhere and need to be kept in check.

- **Microbial growth in food can be controlled by controlling time and temperature**
- **Bacteria die at high temperatures**
- **They stop growing and remain dormant at low temperatures**
- **However spores may survive boiling temperatures unless boiled for sometime.**

Controlling Time and Temperature is necessary



ACTIVITY 2

- Write the correct words from the box in the gaps

Bacteria

Common cold

Round worms

Mold

Bread

- **Eggs ofare transmitted through sewage contaminated food and through the faecal- oral route.**
- **Bread, jam, cheese and pickles are mainly spoiled by..... growing on the surface of the food.**
- **Yeast can ferment sugar and starch to ethyl alcohol and CO₂ and is used in making.**
- **Viruses are strict parasites and when air-borne cause the**
- **Most food infections and food poisonings are caused by**

ACTIVITY 2

Answers

- Eggs of **Round worm** are transmitted through sewage contaminated food and through the faecal- oral route
- Bread, jam, cheese and pickles are mainly spoiled by **Mold** growing on the surface of the food.
- Yeast can ferment sugar and starch to ethyl alcohol and CO₂ and is used in **Bread** making.
- Viruses are strict parasites and when air-borne cause the **Common cold**.
- Most food infections and food poisonings are caused by **Bacteria**.

ACTIVITY 3

- Study the chart titled 'Bacterial growth' and note the rapid rate of multiplication of bacteria under favorable conditions.
- Note that bacteria multiply by dividing into two every 20 minutes
- Calculate on paper, time taken for one bacterial cell to become more than 500



ACTIVITY 3

Answer

- **512 bacteria in exactly three hours**



ACTIVITY 4

Study the chart on Effect of temperature on microbial growth and answer the following statements.

Explain what happens to bacteria when perishable food is stored in the:-

- refrigerator
- freezer
- store room
- left in a warm kitchen
- reheated to be served.

ACTIVITY 4

Answers

- Refrigerator – **Bacteria grow slowly**
- Freezer – **Bacteria remain dormant**
- Storeroom – **Some bacterial growth takes place**
- Warm Kitchen – **Bacteria grow rapidly**
- Reheating – **While reheating cold food it passes through the 'Danger Zone' and bacteria multiply. If reheated properly above 74 °C bacteria die.**

ACTIVITY 5- Demonstration on setting of Curd

Explain basic factors (food, moisture, temperature, time) required for bacterial growth by actually setting a bowl of curds. Use milk which has Been previously boiled.

- **Ingredients –**

- Warm milk - 250 ml
- Curd – 1 tsp
- Two bowls with lids
- Refrigerator

- **Method –**

- Add curds to the warm milk and mix well.
- Pour milk into two bowls and cover
- Keep one bowl in the refrigerator and leave the other bowl in the laboratory.
- Observe both the bowls after 6 to 8 hours, taste the contents and answer the following questions



Good for digestive system
Curd is good food supplement
Cures mineral and vitamin deficiency
Curd is Anti-ageing
Lactose intolerance and curd
Useful in treating Insomnia

ACTIVITY 5- Demonstration on setting of Curd

- **Questions:**

- Why did the bowl of curds kept in the refrigerator not set
- Why did the bowl of curds kept at room temperature set
- Why does curd taste sour
- Why did the curd not set immediately



ACTIVITY 5- Demonstration on setting of Curd

Answers

- Microorganisms need warmth to grow. Refrigerator temperature is 1 to 4 °C.
- Temperature is within the danger zone.
- Lactose sugar in milk is converted to lactic acid.
- Microorganisms need time to multiply.

ACTIVITY 6

ASSIGNMENT

- Take a small piece of chappati/ bhakri/ bread from your lunch box. Touch it with moist hands and keep it in a small closed container. Keep the container undisturbed in a dark corner of your cupboard for 5 days. Open the container after 5 days, and observe changes in the chappati. Write down your observations and answer the following:
 1. Does the chappati look fit for consumption?
 2. Identify the growth on chappati and describe it?
 3. Where do you think this growth has come from?
 4. Why did this particular microorganism grow on it?
 5. What precautions could you have taken to prevent the growth from occurring?

ACTIVITY 6

Answers

1. Does the chappati look fit for consumption?

No it is spoilt/unfit to be eaten and should be discarded.

2. Identify the growth on chappati and describe it?

Mold growth - cottony/powdery white, yellow, grey, black, green etc.

3. Where do you think this growth has come from?

From spores in the air, hands, container and equipment.

4. Why did this particular microorganism grow on it?

Molds are saprophytes and need less moisture to grow.

5. Precautions to be taken to prevent the growth from occurring?

Do not handle food with wet hands and keep food out of 'Danger Zone'.



ACTIVITY 7

Give reasons for the following:

- 1. Why boiled milk spoils quickly in summer if it is not refrigerated?**
- 2. Why water to be boiled for drinking should be allowed to boil for a couple of minutes?**
- 3. Why perishable food should not be left in the Danger Zone?**
- 4. What is the significance of human body temperature in promoting growth of microorganisms in and on our body?**
- 5. Why ice-cream does not spoil in spite of containing adequate moisture and perishable ingredients like milk and cream.**



ACTIVITY 7

Answers

- 1. Why boiled milk spoils quickly in summer if it is not refrigerated.**
 - Milk is highly perishable. Bringing milk to a boil does not destroy all microorganisms and chances of re-contamination are high. Some pathogenic microorganisms or their spores remain and they multiply rapidly to numbers large enough to cause curdling of milk.**
- 2. Why water to be boiled for drinking should be allowed to boil for a couple of minutes.**
 - Boiling does not destroy all microorganisms. Very often some pathogenic microorganisms or their spores remain in water.**



ACTIVITY 7

Answers

3. Why perishable food should not be left in the Danger Zone.

- **Perishable foods like raw meat, fish, milk etc. are rich in nutrients and moisture and if given warmth and time they spoil rapidly. They have a short shelf life so should not be left in the danger zone for more than 2 hours.**

4. Significance of human body temperature in promoting growth of microorganisms in and on our body.

- **Human body temperature is 37 ° C. Between 15 ° C and 49 ° C microbial growth is maximum and conditions are favorable for their growth in terms of food and moisture from body secretions.**

ACTIVITY 7

Answers

- 5. Why ice-cream does not spoil in spite of containing adequate moisture and perishable ingredients like milk and cream.**
- **Ice-cream is stored in the freezer at -18° C. When food is frozen microbes do not die but remain dormant.**



Conclusion

- Now that we know what microbes are and that some microbes can make us sick and spoil our food, we are able to understand the need for hygiene better. In the following modules we will study how they are spread and how they can be controlled through practising-
- Personal hygiene
- Hygienic Handling of Food and
- Hygiene of our surroundings





EU-India Capacity Building Initiative for Trade Development(CITD)



Thank you

