Environmental monitoring for quality assurance

For each category below, follow the link to a web page and use the information from that site to answer the questions. You may have to do additional searches for some items.

Aerobic bacteria

biologyonline.com/dictionary/aerobic-bacteria

Oxygen-loving microorganisms

Aerobic bacteria, also known as aerobes, are microorganisms that require oxygen for survival and growth. These bacteria thrive in environments with ambient air, which typically contains about 21% oxygen. Aerobic bacteria use oxygen as a key component in their energy production processes, including aerobic respiration and the Krebs cycle. Understanding how these bacteria function and their importance in various ecosystems is crucial for students of biology and microbiology.

Fill in the blanks

Word bank: *electron, fermentation, oxygen, TCA, aerobic*

1. Aerobic bacteria require _____ for survival and growth.
2. The Krebs cycle is also known as the _____ or citric acid cycle.
3. In aerobic respiration, oxygen serves as the terminal _____ acceptor.
4. *Bacillus cereus* is an example of a(n) _____ bacterium.
5. Anaerobic bacteria derive energy through anaerobic respiration and _____.

Multiple choice

1. What percentage of oxygen is typically found in ambient air?
   a. a. 10% b. 21% c. 50% d. 78%
2. Which of the following is *not* a process used by aerobic bacteria to generate energy?
   a. Oxidative phosphorylation
   b. Glycolysis
   c. Krebs cycle
   d. Alcoholic fermentation
3. What molecule do anaerobic bacteria use as an electron carrier during fermentation?
   a. ATP b. NADH c. Oxygen d. Carbon dioxide
4. Which of the following best describes anaerobic bacteria?
   a. Bacteria that require oxygen for survival
   b. Bacteria that can survive with or without oxygen
   c. Bacteria that do not require oxygen for survival
   d. Bacteria that only survive in high-oxygen environments

5. What is the main function of the Krebs cycle in aerobic bacteria?
    a. To break down glucose
    b. To generate ATP molecules
    c. To remove oxygen from the environment
    d. To produce carbon dioxide

Open-ended questions

1. Explain why oxygen is essential for aerobic bacteria and describe one process they use to generate energy.

2. Compare and contrast aerobic and anaerobic bacteria in terms of their energy production methods.

3. Describe the potential impact of changing oxygen levels in an environment on the growth of aerobic bacteria.

Types of aerobic bacteria

Aerobic bacteria are microorganisms that require oxygen to survive and thrive. These bacteria play crucial roles in various ecosystems and have different relationships with oxygen. There are four main types of aerobic bacteria: obligate aerobes, facultative aerobes, microaerophiles, and aerotolerant aerobes. Each type has unique characteristics and adaptations that allow them to interact with oxygen in different ways.

Fill in the blanks

Word bank: *superoxide dismutase, microaerophiles, facultative, obligate, aerotolerant.*

1. _____ aerobes cannot survive without oxygen and require it for their metabolic processes.
2. Bacteria that can survive with or without oxygen are called _____ aerobes.
3. _____ need only a small amount of oxygen and can be harmed by high oxygen levels.
4. _____ do not use oxygen for energy production but can tolerate its presence.
5. Obligate aerobes use enzymes like catalase, peroxidase, and _____ to counter the toxic effects of reactive oxygen species.

Multiple choice questions

1. Which of the following is an example of an obligate aerobe?
   a. *Enterobacteriaceae* b. Lactobacilli c. Pseudomonas d. Helicobacter

2. What process do aerobic bacteria use to generate energy?
   a. Fermentation only
   b. Glycolysis and fermentation
   c. Glycolysis, electron transport chain, and Krebs cycle
   d. Anaerobic respiration

3. Which type of aerobic bacteria can cause tuberculosis?
   a. Pseudomonas aeruginosa
   b. Mycobacterium tuberculosis
   c. Nocardia
   d. Salmonella

4. Aerotolerant aerobes lack which of the following enzymes?
   a. Catalase b. Peroxidase c. Superoxide dismutase d. All of the above

5. Which genus of bacteria is associated with food-borne illnesses?
   a. Achromobacter b. Klebsiella c. Citrobacter d. Salmonella

Open-ended questions

Answer the following questions in complete sentences.

1. Explain the main difference between obligate aerobes and facultative aerobes.

2. Describe how microaerophiles differ from other types of aerobic bacteria in terms of their oxygen requirements.

3. Provide two examples of aerobic bacteria and briefly explain their importance or impact on human health.

Biological and ecological roles of aerobic bacteria

Aerobic bacteria are microorganisms that require oxygen to survive and thrive. These bacteria play crucial roles in various ecological processes and biological functions. They are essential for decomposition, waste treatment, and even some disease processes. Aerobic bacteria are found in diverse environments such as soil, water, and living organisms, where they contribute to the balance of ecosystems and the cycling of nutrients.

Fill in the blanks

Word bank: *biological, aerobic, dissolved, soil, oxygen, pathogenic.*

1. Aerobic bacteria play a vital role in _____ degradation, especially in the presence of oxygen.
2. The decomposition of organic material on the forest floor is primarily an _____ process.
3. In wastewater treatment, aerobic bacteria utilize _____ oxygen to degrade pollutants.
4. The majority of _____ bacteria are aerobic and help in degrading soil contaminants.
5. Some disease-causing bacteria, like *Mycobacterium tuberculosis,* are _____ and can remain dormant for years.

Multiple choice questions

1. Which of the following is *not* a characteristic of aerobic composting?
   a. It requires oxygen.
   b. It produces a strong, unpleasant odor.
   c. It accelerates hydrocarbon degradation.
   d. It involves the decomposition of organic material.
2. Aerobic bacteria in wastewater treatment:
   a. Produce oxygen
   b. Remove dissolved oxygen from water
   c. Use dissolved oxygen to break down pollutants
   d. Increase the level of pollutants in water
3. Which of the following is an example of an aerobic soil bacterium?
   a. *Clostridium botulinum*
   b. *Aerobacter sp.*
   c. *Methanobacterium*
   d. *Desulfovibrio*
4. The rate of decomposition by aerobic bacteria:
   a. Increases with higher levels of carbon dioxide
   b. Decreases with higher levels of carbon dioxide
   c. Is not affected by carbon dioxide levels
   d. Increases only in the absence of oxygen
5. Which of the following is an aerobic pathogenic bacterium?
   a. *Clostridium tetani*
   b. *Bacteroides fragilis*
   c. *Escherichia coli*
   d. *Peptostreptococcus*

Open-ended questions

1. Explain how aerobic bacteria contribute to the decomposition process in a forest ecosystem.

2. Describe the role of aerobic bacteria in wastewater treatment and how this process benefits the environment.

3. Compare and contrast the ecological roles of aerobic bacteria in soil and water environments.

Enterobacteriaceae: exploring intestinal microbes

biologyonline.com/dictionary/enterobacteriaceae

Enterobacteriaceae is a family of gram-negative bacteria that primarily inhabit the large intestine of humans and other mammals. These microorganisms play a crucial role in our digestive system, with most being harmless or even beneficial. However, some members of this family can become opportunistic pathogens under certain conditions. Understanding these bacteria is essential for comprehending gut health and potential infections.

Fill in the blanks

Word bank: *anaerobes, large, gram-negative, grey, 1–5.*

1. *Enterobacteriaceae* are classified as _____ bacteria due to their cell wall structure.
2. Most *Enterobacteriaceae* are found in the _____ intestine of mammals.
3. These bacteria are facultative _____, meaning they can survive with or without oxygen.
4. *Enterobacteriaceae* typically measure between _____ micrometers in length.
5. On blood agar, *Enterobacteriaceae* colonies appear as small _____ formations.

Multiple choice questions

1. Which of the following is *not* a characteristic of most *Enterobacteriaceae*?
   a. They are gram-negative.
   b. They are spore-forming.
   c. They can ferment sugars.
   d. They lack cytochrome C oxidase.
2. What beneficial role do some *Enterobacteriaceae* play in the human body?
   a. Producing vitamin C
   b. Synthesizing vitamin K
   c. Generating antibodies
   d. Creating red blood cells

3. Which of these is an example of a disease that can be caused by pathogenic *Enterobacteriaceae*?
   a. Pneumonia b. Gastroenteritis c. Arthritis d. Alzheimer's disease
4. What is the primary locomotory organ of many *Enterobacteriaceae*?
   a. Pili b. Fimbriae c. Flagella d. Cilia
5. Which of the following is an exception to the typical nitrate reduction ability of *Enterobacteriaceae*?
   a. *Escherichia coli*
   b. *Salmonella typhi*
   c. *Photorhabdus species*
   d. *Klebsiella pneumoniae*

Open-ended questions

Research each of these bacteria that fall under *Enterobacteriaceae* and determine if they are commensal or pathogenic to humans. If they are pathogenic, list the disease or ailment they may cause.

1. *Citrobacter*
2. *Cronobacter*
3. *Enterobacter*
4. *Escherichia,* e.g. *E. coli*
5. *Hafnia*
6. *Klebsiella*
7. *Pantoea*
8. *Plesiomonas*
9. *Proteus*
10. *Raoultella*
11. *Salmonella*
12. *Serratia*
13. *Shigella*

Yeast and mold

fda.gov/food/laboratory-methods-food/bam-chapter-18-yeasts-molds-and-mycotoxins

Microscopic foodborne fungi: yeasts and molds

Yeasts and molds are microscopic fungi that can contaminate various foods. These organisms have diverse environmental requirements, allowing them to grow on many different food types. Yeasts and molds can cause food spoilage, leading to economic losses and potential health risks. Some molds produce toxic substances called mycotoxins, which can be harmful to humans and animals. Understanding the characteristics and effects of these fungi is crucial for food safety and quality control.

Fill in the blanks

Word bank: *0.85, direct, toxic, microscopic, obligate.*

1. Yeasts and molds are classified as _____ organisms that can contaminate food.
2. Most yeasts and molds are _____ aerobes, meaning they require free oxygen for growth.
3. Foodborne molds can grow at a water activity (aw) of _____ or less.
4. Mycotoxins are _____ metabolites produced by some foodborne molds.
5. The _____ plating method is more efficient for detecting individual mold species.

Multiple choice questions

1. What is the typical temperature range for growth of most yeasts and molds?
   a. 0–10°C b. 10–35°C c. 35–50°C d. 50–70°C
2. Which of the following is *not* a common sign of mold contamination in food?
   a. Rot spots
   b. White cottony mycelium
   c. Increased nutritional value
   d. Abnormal flavors and odors
3. How do mycotoxins typically respond to food processing or home cooking?
   a. They are easily destroyed.
   b. They become more toxic.
   c. They remain stable.
   d. They evaporate completely.
4. Which group of people is more susceptible to infections caused by foodborne fungi?
   a. Professional athletes
   b. Children under 5
   c. Immunocompromised individuals
   d. Pregnant women
5. What is the primary purpose of the direct plating method in fungal detection?
   a. To count the total number of fungi
   b. To identify specific mold species
   c. To measure mycotoxin levels
   d. To determine the pH of the food

Open-ended questions

1. Explain why yeasts and molds can contaminate such a wide variety of foods.

2. Describe two potential health risks associated with the consumption of food contaminated by molds.

3. Why is it important for food producers and processors to prevent fungal contamination in their products?