

# A221: Microbiology

## Problem 2: Food! Glorious Food!

### WORKSHEET

#### Question 1

Draw a line to match the animals to their correct habitats.



Sheeps

Fish

Camel

Polar bear



- a) What are some of the considerations in matching them?  
Some of the considerations in matching them are their characteristics, adaptations, temperature of the environment, the food available and salinity in that habitat.
- b) What will happen if you place them in the wrong habitats?  
The animals will die as they may be unable to adapt if they are placed in the wrong habitats.
- c) What is the main source of food for the animals listed above, based on their natural habitats?  
The main source of food for the animals are grass, water, meat, algae, small fishes.

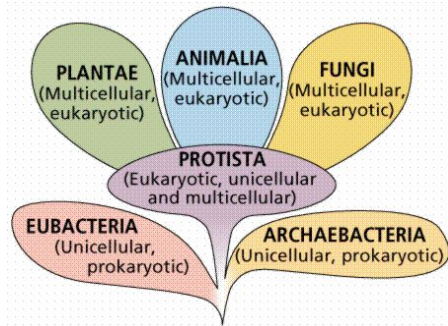
#### Question 2

With reference to the video, answer the following questions:

- a) In this video, it was mentioned that there is a “category of life that is largely unexplored”. What does the “category of life” in this video refer to?

The “category of life” in this video refer to the different species.

- b) What are some examples of the “category of life” mentioned in the video?



- c) What are some of the places where microbes can be found in?

Some of the places where microbes can be found in is everywhere. Even our table has some microbes that we cannot see with our naked eye.

### Question 3

We eat when we are hungry.

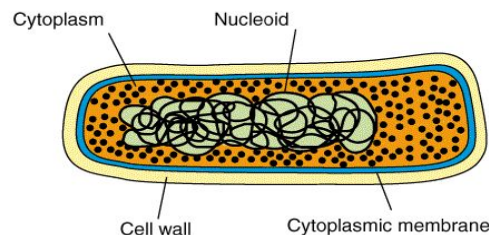
- a) What are some of the nutrients that we obtain from our food?

Some of the nutrients that we obtain from our food are carbohydrates, fats, proteins, vitamins.

- b) Why do you think our body needs these nutrients?

Our body needs these nutrients for survival, cellular activities and energy source.

- c) The figure below shows a diagram of a bacterium.



Do bacteria need nutrients? Why.

Yes, bacteria need nutrients in order to survive. They need to carry out essential cellular activities in order to live. Nutrients would also allow bacteria to be healthy.

d) What are some of the common elements found in nutrients that the bacterium will need?

Some of the common elements found in nutrients that the bacterium will need are carbon, hydrogen, oxygen, phosphorus, nitrogen, sulfur

e) With the help of this [link](#), fill up the table below to have a better understanding on the types, source and function of some elements essential for bacterium survival.

Element	Source	Function
Carbon	organic compounds or CO <sub>2</sub>	Main constituent of cellular material
Oxygen (air)	Organic compounds, CO <sub>2</sub> , and O <sub>2</sub>	Constituent of cellular material and cell water; O <sub>2</sub> is an electron acceptor in aerobic respiration
Nitrogen (soil)	NH <sub>3</sub> , NO <sub>3</sub> , organic compounds, N <sub>2</sub>	Constituent of amino acids, nucleic acids nucleotides, and coenzymes
Hydrogen (air)	Organic compounds, H <sub>2</sub>	Main constituent of organic compounds and cell water
Phosphorus	Inorganic phosphates (PO <sub>4</sub> )	Constituent of nucleic acids, nucleotides, phospholipids, LPS, teichoic acids

#### **Question 4**

a) With references to the pre-reading, state the 4 major categories under which microorganisms are classified.

The 4 major categories are nutritional requirements, energy requirements, temperature range and oxygen requirements.

b) Fill up the table below to have a better understanding on the classification of microorganisms accordingly to their carbon and energy source.

Nutritional types of microorganisms	Energy source	Carbon source	Examples of microorganisms
Photoautotrophs	Sunlight	Carbon dioxide	Photosynthetic organisms
Chemoautotrophs	Inorganic matter	Carbon dioxide	Methanogens
Photoheterotroph	Sunlight	Organic	Nonsulphur bacteria

Chemoheterotrophs	Organic matter from other organisms	Organic	Fungi, many bacteria, animals
Heterotrophic	Organic	Organic	Decomposers like bacteria and fungi

c) Microorganisms may also be classified based on their optimal growth temperature. Fill in the table below:

Types of microorganisms	Optimal growth temperature	Habitat source	Examples of microorganisms
Hyperthermophile	70°C and upwards	Hot Spring	<i>Pyrococcus furiosus</i> <i>Pyrolobus fumarii</i>
Thermophile	45°C - 70°C		
Mesophiles	20°C - 45°C	bread, grains, dairies, meat, beer, wine	<i>Bacteria and fungi</i> <i>Escherichia coli</i> <i>Staphylococcus aureus</i> <i>Clostridium botulinum</i>
Psychrophile	-5 to 20°C.	Deep oceans, polar surface, polar icecap regions, frozen foods	<i>Psychrobacter</i> , <i>Arthrobacter luteus</i>

d) List the types of nutrients that can be found in each of the habitat in Part i) of the table below? Base on the listed nutrients, classify the nutritional types of the microorganisms that can be found in each of the habitat in Part ii) of the table.



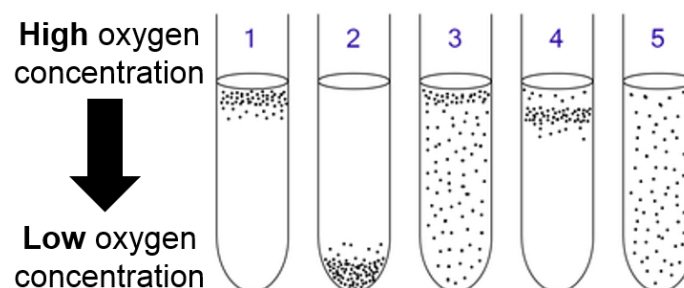
Habitat	Deep sea hydrothermal vent	Hot spring	Surface of freshwater Lake	Gastrointestinal tract
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1a) Carbon sources	CO <sub>2</sub>	Inorganic compounds (S, H <sub>2</sub> ), CO <sub>2</sub>	Air, light, organic compounds	Air, organic compounds
1b) Energy sources	Inorganic compound (S, H <sub>2</sub> )	Light	Sunlight	Food (Carbohydrates, lipids, proteins, nucleic acid)
2) Nutritional types of microorganisms	Hyperthermophilic Chemoautotrophs	Thermophilic Photoautotroph	Psychrophilic Photoheterotrophs	Mesophilic Chemoheterotrophs

### **Question 5**

Besides nutrients availability, other factors can also influence microbial growth, such as atmospheric gases.

- a) Of all the atmospheric gases that can influence microbial growth, oxygen is the one that has the greatest impact on microbial growth. The diagram below illustrates where various microbes will grow (based on its oxygen requirements) in a tube of thioglycollate broth.



- i) Why is thioglycollate broth used?  
Thioglycollate broth is used as a medium designed to test the aerotolerance of bacteria, to support bacteria growth.
- ii) Where are the locations of bacterial growth in all the five tubes?
1. Concentrated close to surface
  2. Concentrated close to bottom of the tube
  3. Concentrated at the top and spread throughout the tube
  4. Concentrated close but a short distance away from the surface
  5. Spreaded throughout the tube

iii) Categorise the 5 types of microbes (in the 5 individual tubes) based on their respective oxygen requirements.

1. Obligate aerobes
2. Obligate anaerobes
3. Facultative anaerobes
4. Microaerophiles
5. Aerotolerant anaerobes

### **Question 6**

Microbial growth and survival are also influenced by the pH of the environment they are found in.

a) What do you understand by the term 'pH'?

The term 'pH' is a scale of acidity from 0 to 14. The pH shows us how acidic or alkaline a substance is.

b) What is the estimated pH of

- a. Pickled food pH 4.6
- b. Water pH 7
- c. Soil containing high levels of basic minerals pH more than 7

c) Which kind of microbes would you be able to find in pickled food and soil containing high levels of basic minerals respectively? Explain your answer.

Acidophiles would be found in pickled food and alkaliphiles would be found in soil containing high levels of basic minerals.

d) Suggest other environmental factors that can affect the growth and viability of microorganisms.

Other environmental factors that can affect the growth and viability of microorganisms are temperature.

### **Question 7**

a) What makes the environments below unique?





- b) Refer to [link](#) and answer the question. How do microorganisms thrive in such harsh and differing conditions?

They use a 'structure-based' mechanism, which increases compactness of their proteins resulting in their stabilisation.

They also use a 'sequence-based' mechanism, where proteins are stabilised by changes in their amino acid sequence, which then allow the formation of additional salt bridges or other specific interactions

They accumulate some unusual compatible solutes, such as di-glycerol-phosphate, which might assist in thermal protection of enzymes and proteins.

- c) Some microorganisms have adapted and thrived well under extreme environmental conditions. Scientists have since exploited their unique properties for the development of commercial products or useful applications. State some examples on how they have done so.

These type of microorganisms are known as extremophiles. Under extreme conditions, these microorganisms will undergo endospore formation and a mature spore will be released at the end. A mature spore is resistant to unfavourable conditions of the environment.

### **Going further (Optional):**

To clarify further on the various types of tropism and definition of organic and inorganic compounds present in the environment.

- a. Autotrophs are called self-feeders because they are capable of producing own food by reducing CO<sub>2</sub> into organic compounds like glucose. What is the other name for this common metabolic process seen in some Cyanobacteria, algae and green plants?
- b. Is glucose an organic compound? Define the terms organic and inorganic compounds in the environment we live in.

### **References:**

- [http://www.learner.org/vod/vod\\_window.html?pid=1363](http://www.learner.org/vod/vod_window.html?pid=1363)
- <http://textbookofbacteriology.net/nutgro.html>
- [http://www.mapoflife.org/topics/topic\\_354\\_Extremophiles-Archaea-and-Bacteria/](http://www.mapoflife.org/topics/topic_354_Extremophiles-Archaea-and-Bacteria/)
- <http://www.microbiologyonline.org.uk/about-microbiology/introducing-microbes>
- [http://www.mhhe.com/biosci/genbio/raven6b/graphics/raven06b/enhancementchapters/raven30\\_enhancement.html](http://www.mhhe.com/biosci/genbio/raven6b/graphics/raven06b/enhancementchapters/raven30_enhancement.html)

**~End of Worksheet~**