

Class XII Biology

**MICROBES IN
HUMAN
WELFARE**



TAGORE INTERNATIONAL SCHOOL
NEW DELHI
(Affiliated to C.B.S.E.)

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To access the comic book and additional interactive digital content, download DIKSHA app from Google Play Store on your android smart phone or tablet.

PREFACE

This Graphic Novel is a way for learners to look at Biology through a different lens, in a more enjoyable and accessible way.

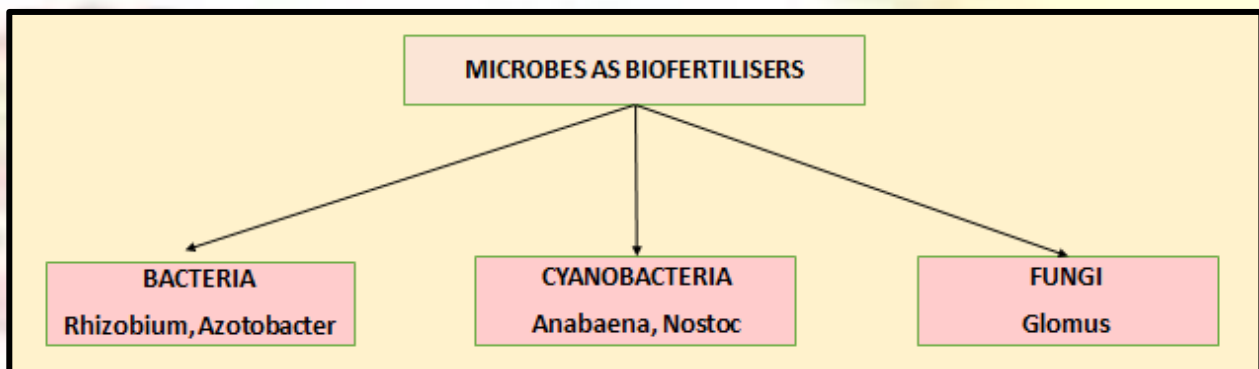
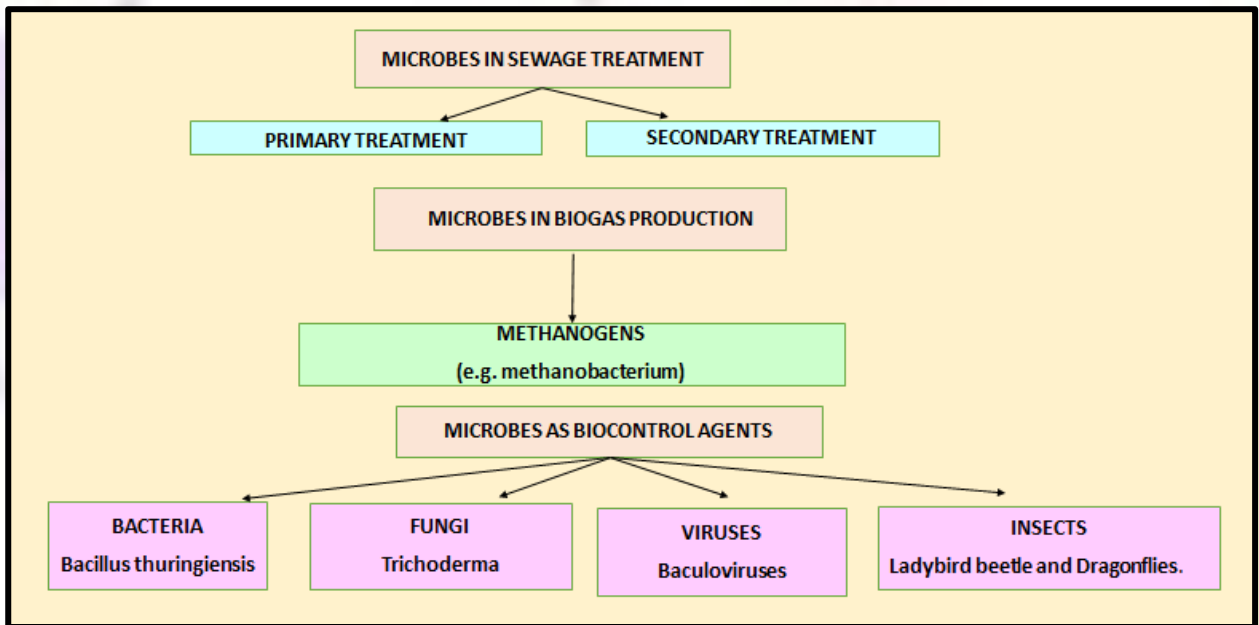
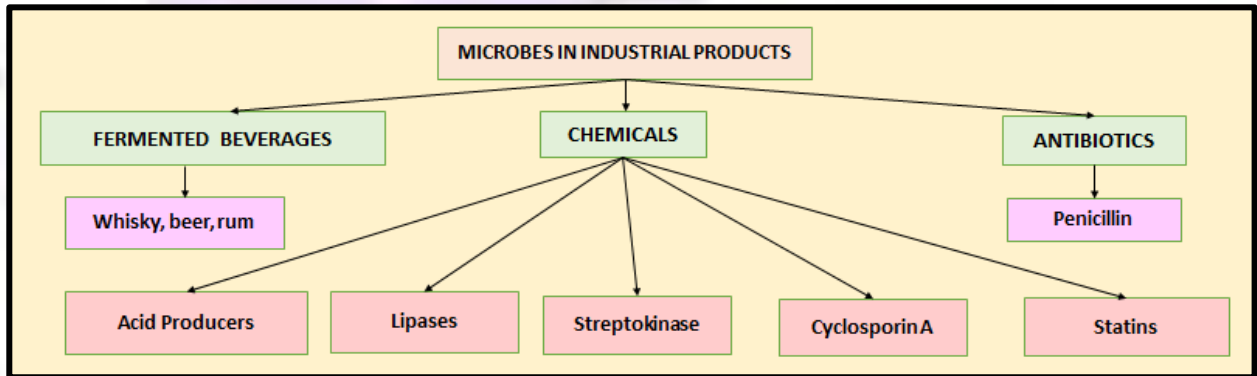
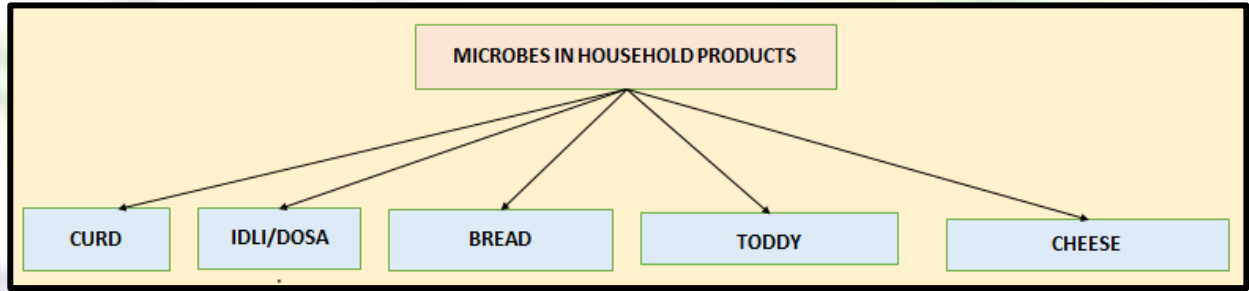
The novel comprises of detailed description of the importance of microbes in human welfare. The learners will be able to analyse the role of microbes in household products, industrial products, in sewage treatment, in production of biogas as well as the role of microbes as biocontrol agents and biofertilisers. Each concept has been illustrated with examples from day-to-day life to facilitate its easy understanding.

The story showcases a class 12 girl who needs to present a PowerPoint Presentation in her class on Microbes in Human Welfare. The story moves forward with the girl who in order to satisfy her inquisitive nature finds different ways of obtaining information for her PPT from her father, mother and organic farmer.

The novel is an effective medium of integration of art with Biology. The art in the novel will make it easier for readers to relate to the characters and imagine how it would feel to be in a similar situation. This will stimulate the learners to read and comprehend it.

The novel will not only promote quick learning and better recall of concepts but will also help the students in acquiring creative thinking and critical thinking skills.

STORY BOARD



LEARNING OUTCOMES

Readers will be able to:

- name the different types of microbes.
- appreciate the role of microbes in day-to-day life.
- explain the role of microbes in household products and industrial products.
- describe the importance of microbes in sewage treatment and in production of biogas.
- identify the pictures of fermentation plant and sewage treatment plant as well as draw a labelled diagram of a typical biogas plant.
- mention the usefulness of microbes as biocontrol agents and as bio fertilisers.
- compare the approach of organic farmers to that of conventional pest control methods.

CHARACTERS

Mr. Sushil Tiwari (father) - He is in his late forties. He is a manager at Sewage Treatment Plant and has great expertise in his field. He is a friendly and responsible person. He is a loving father and devotes time to his family.



Mrs Nita Tiwari (mother) - She is in her early forties and is a Science teacher. She is a doting and caring wife and mother. She has a scientific temperament and is always ready to answer the endless queries of her children.

Shivangi (daughter) - She is 17 years old and is in class 12. She is an obedient and inquisitive girl who is always eager to learn new things. She is very sincere and completes the task assigned to her with dedication.

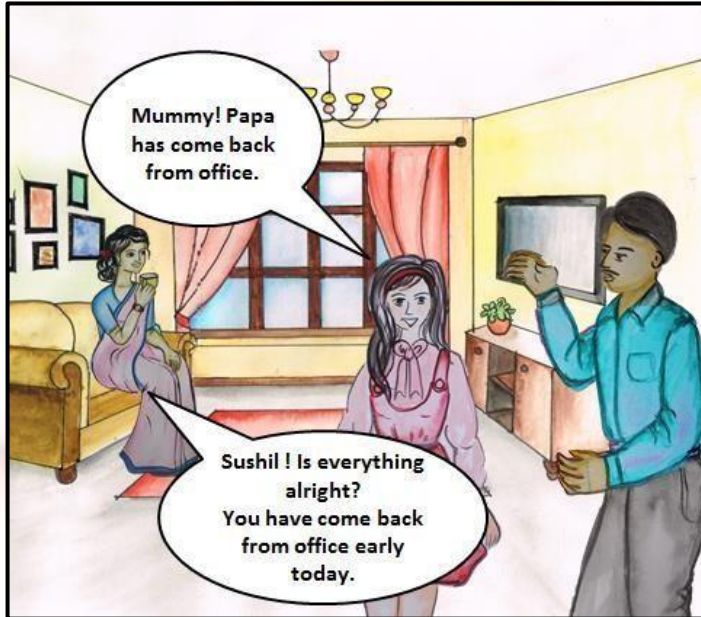
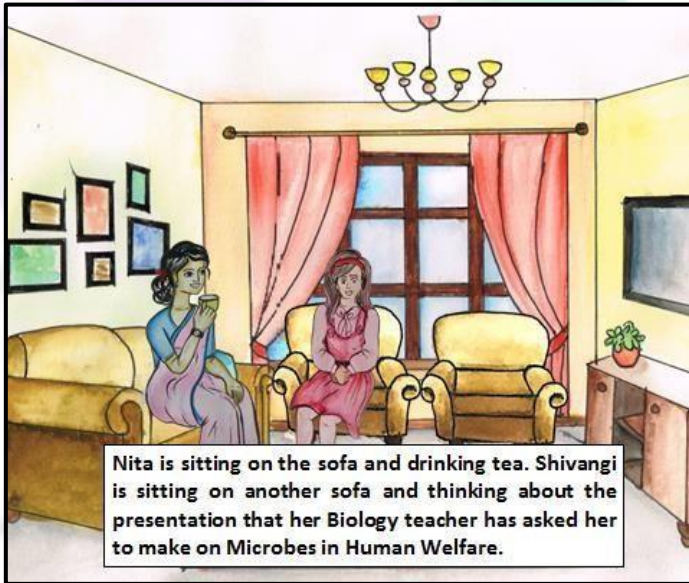


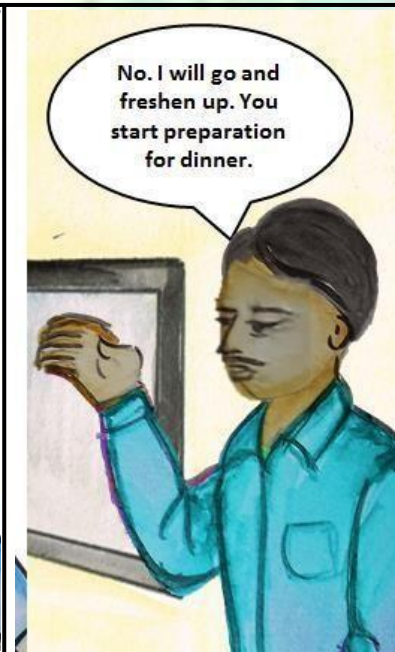
Rishi (son) - He is an active and smart boy of thirteen. He is a curious and enthusiastic learner and has an impressive understanding of the concepts taught to him in his class.

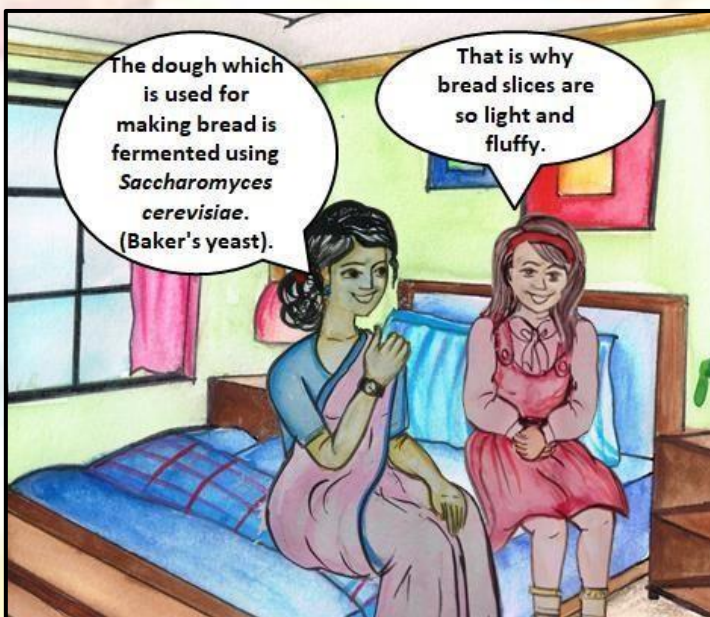
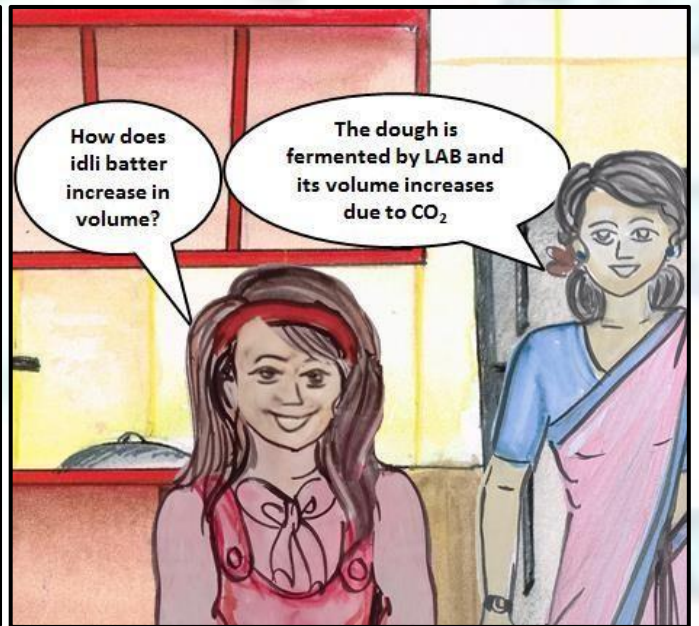
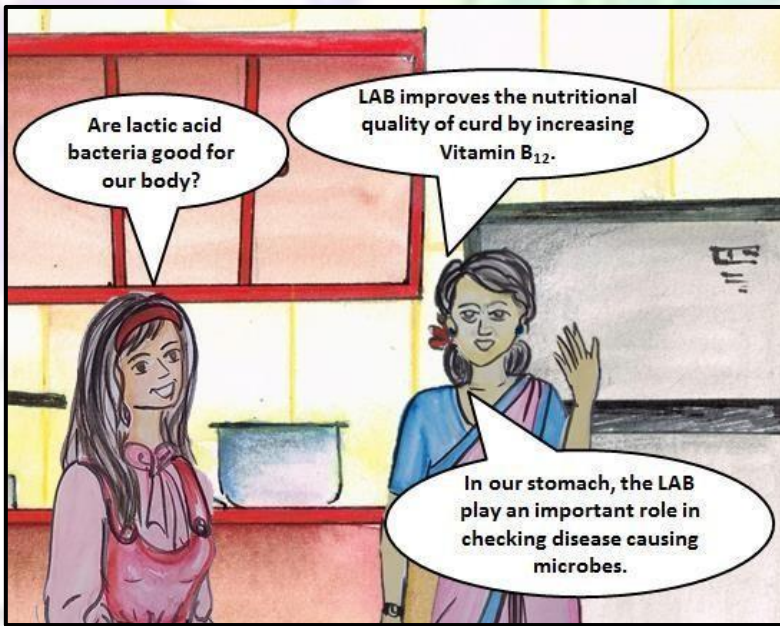
Mr. Ramesh Kumar (organic farmer) - He is 35 years old and owns an organic farm. He is self-driven, diligent, knowledgeable and compassionate person. He advocates sustainable use of resources.

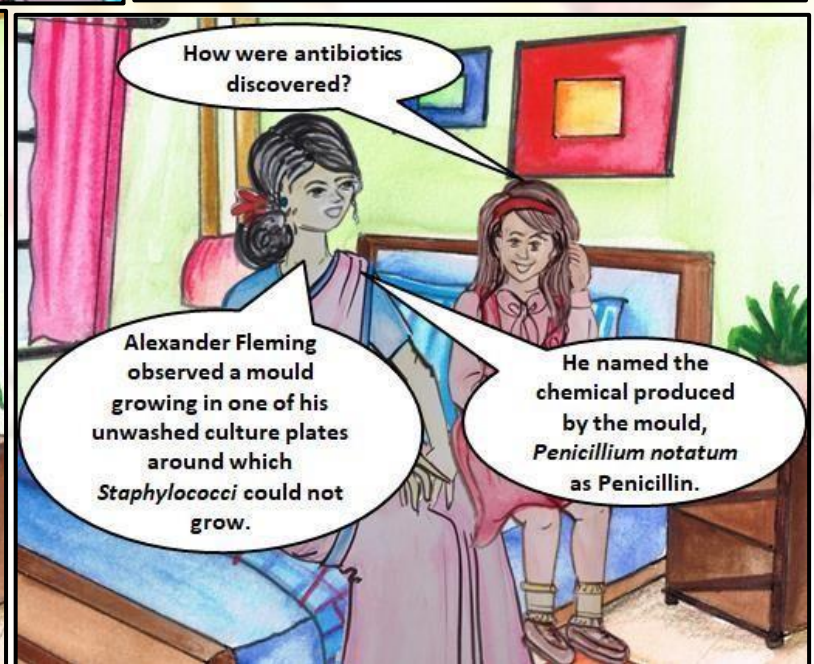
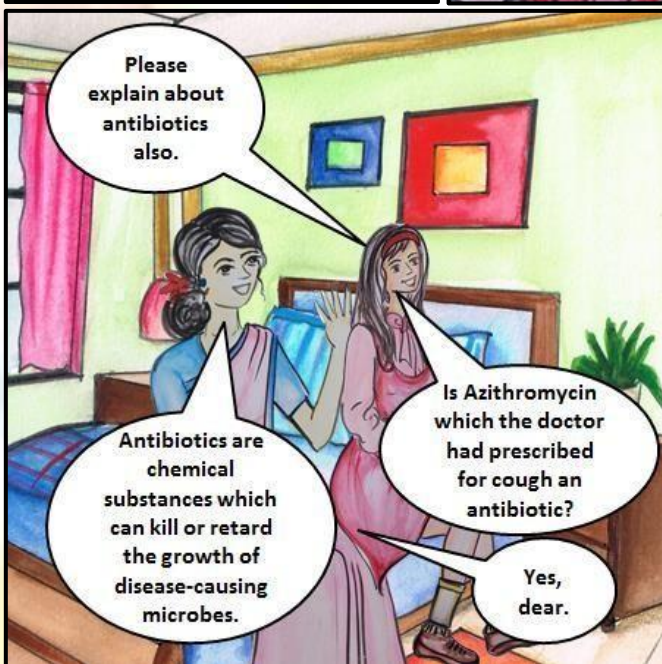
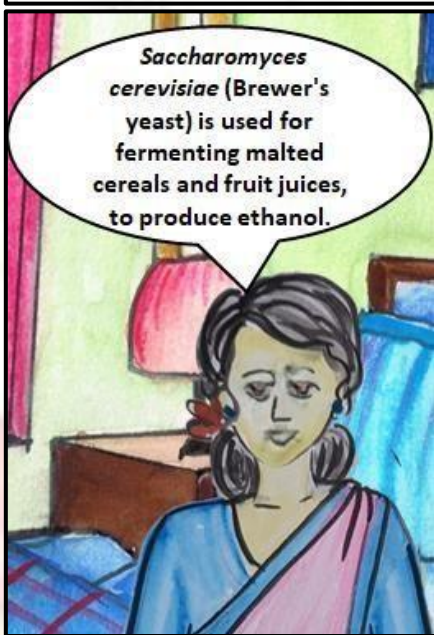
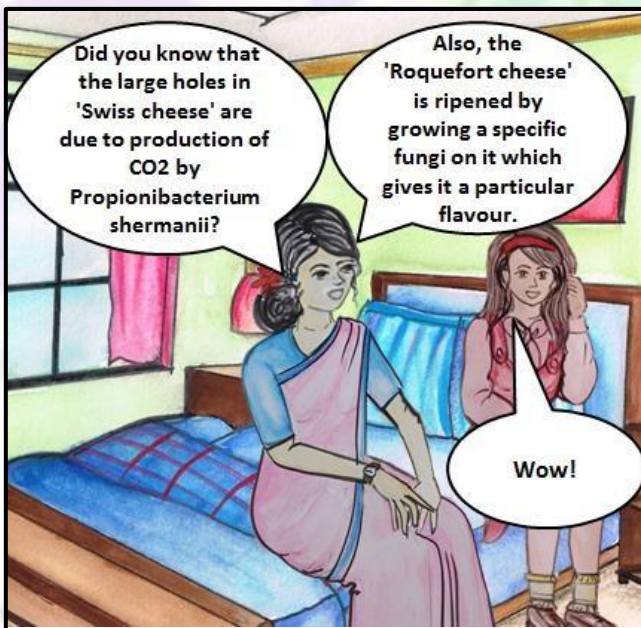


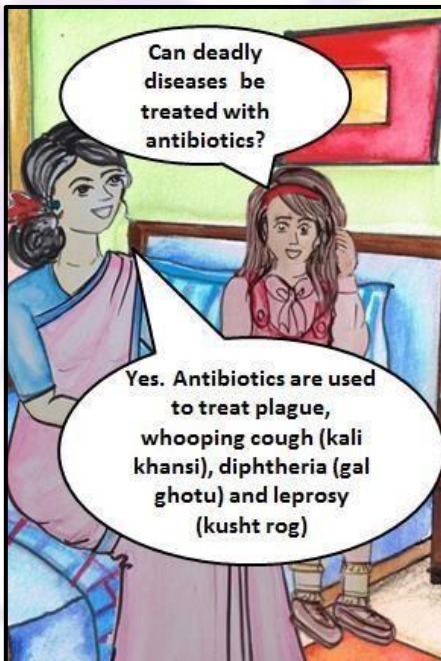
Story- Microbes in Human Welfare











Can deadly diseases be treated with antibiotics?

Yes. Antibiotics are used to treat plague, whooping cough (kali khansi), diphtheria (gal ghotu) and leprosy (kusht rog)



Do microbes play role in other industrial products also?

Yes. Microbes are used for commercial and industrial production of certain chemicals.

I would like to know this in detail.



Aspergillus niger (a fungus) produces citric acid, *Acetobacter aceti* (a bacterium) produces acetic acid.

Clostridium butylicum (a bacterium) produces butyric acid, *Lactobacillus* (a bacterium) produces lactic acid.



Microbes are also used for production of enzymes.

Lipases are used in detergent formulations, helpful in removing oily stains from the laundry.

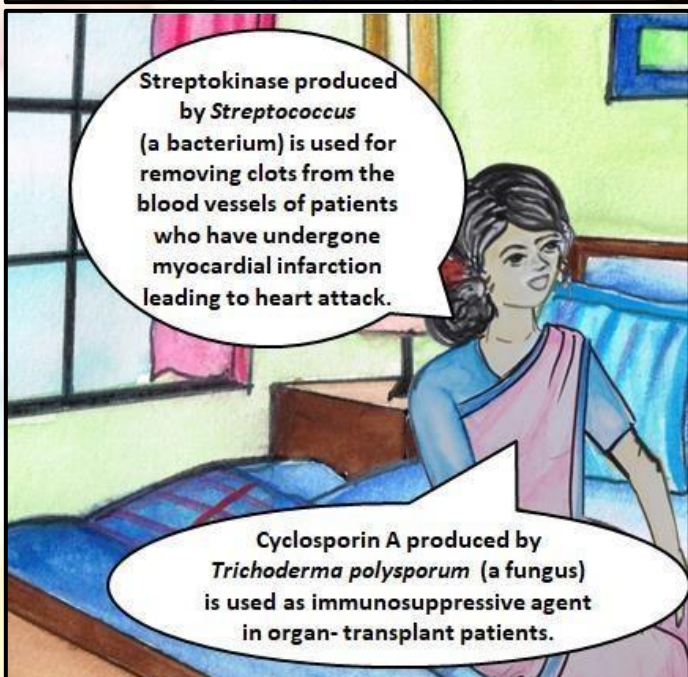
Wow! Washing powders rely on enzymes for extra clean look of clothes.



Bottled fruit juices bought from the market are clearer than those made at home.

They are clarified by the use of pectinases and proteases.

That's Wonderful!



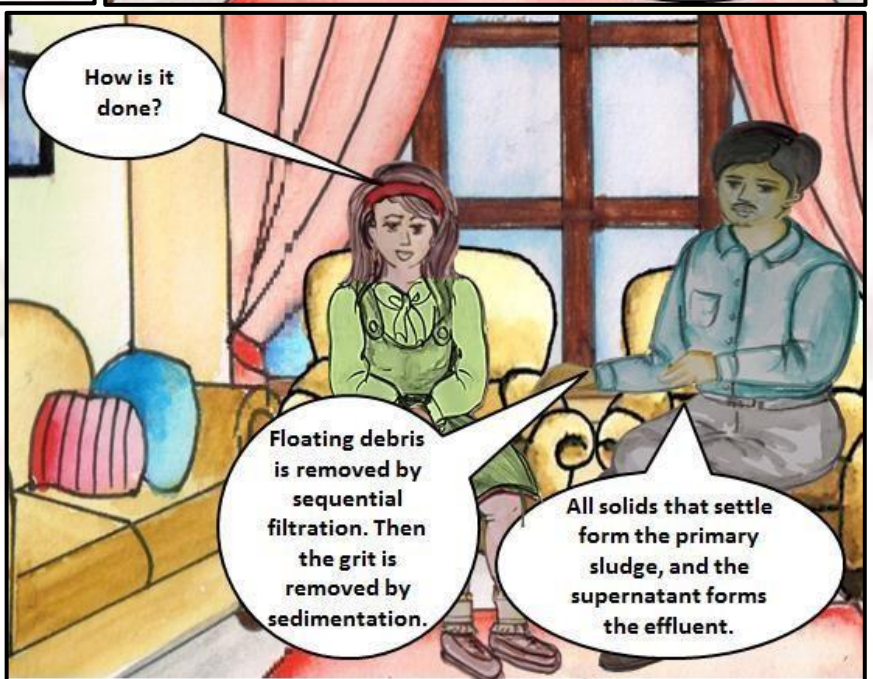
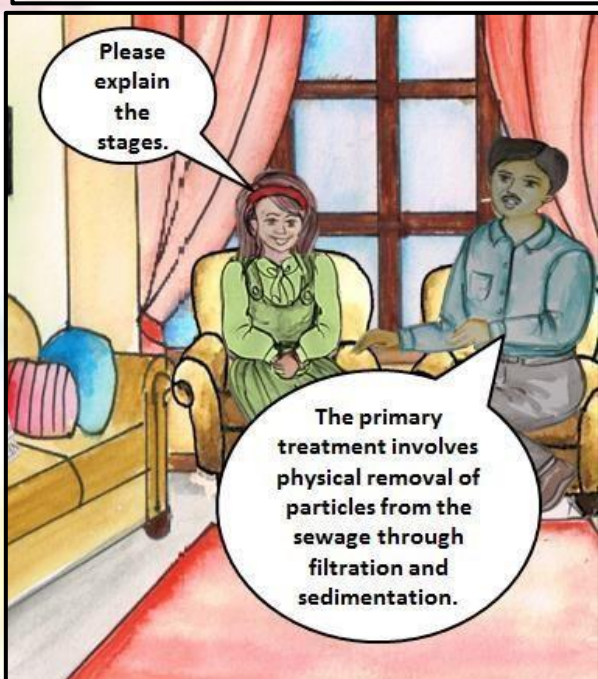
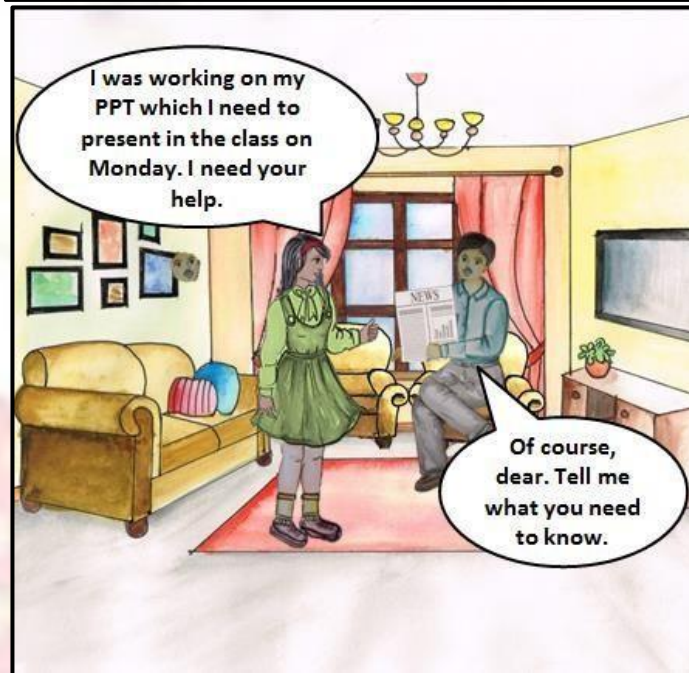
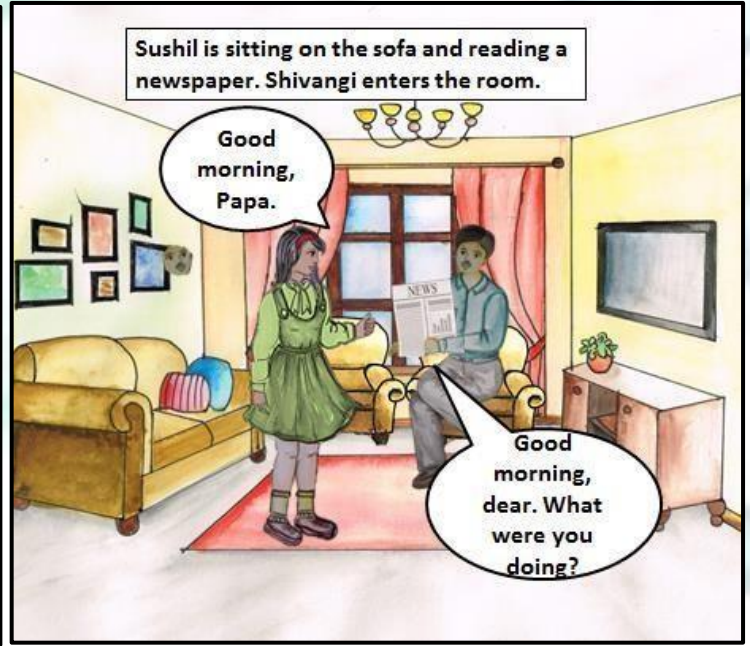
Streptokinase produced by *Streptococcus* (a bacterium) is used for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

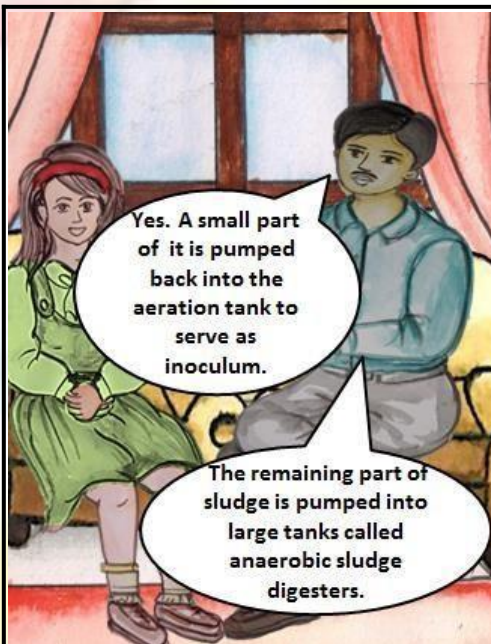
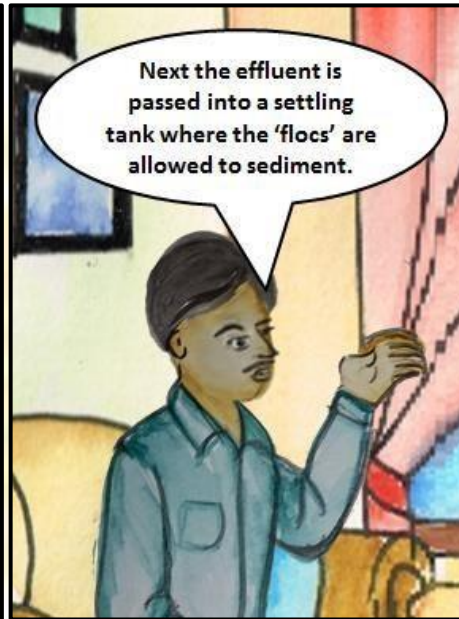
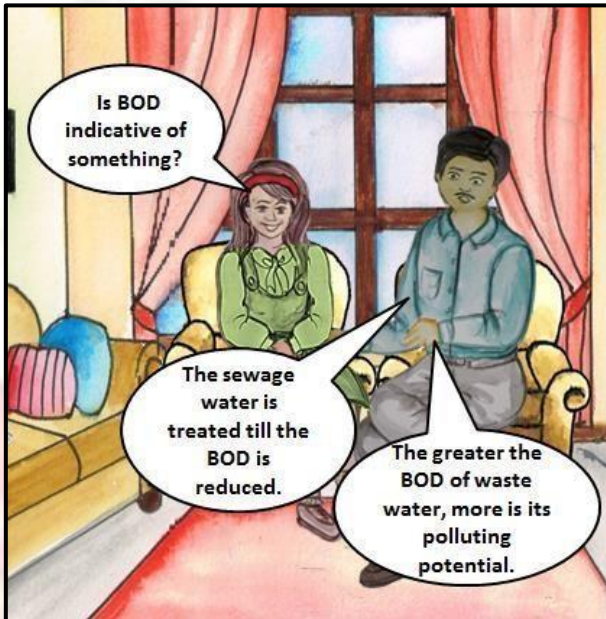
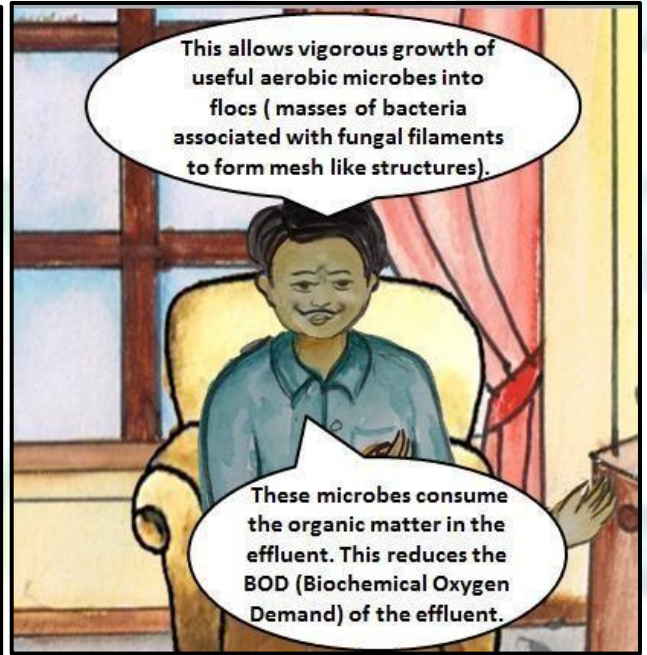
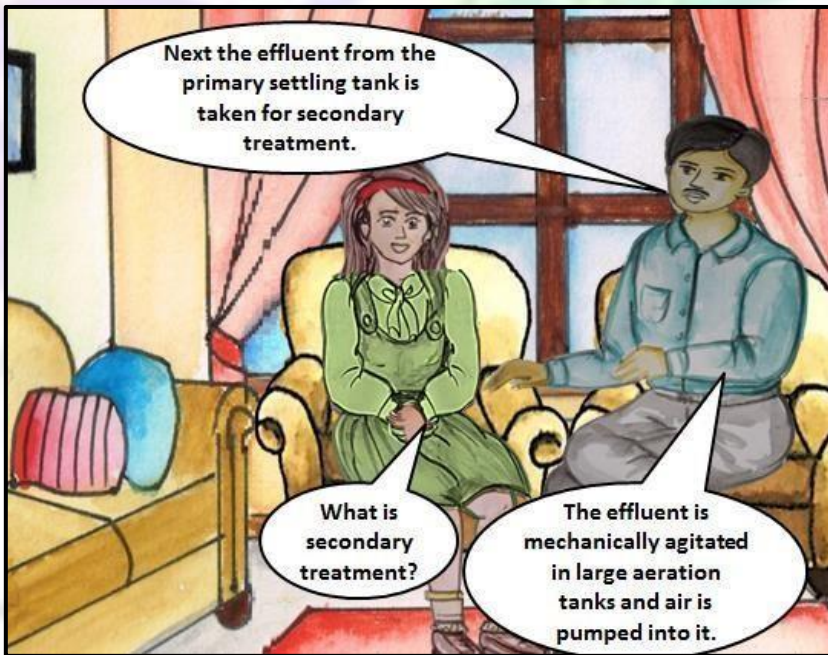
Cyclosporin A produced by *Trichoderma polysporum* (a fungus) is used as immunosuppressive agent in organ-transplant patients.

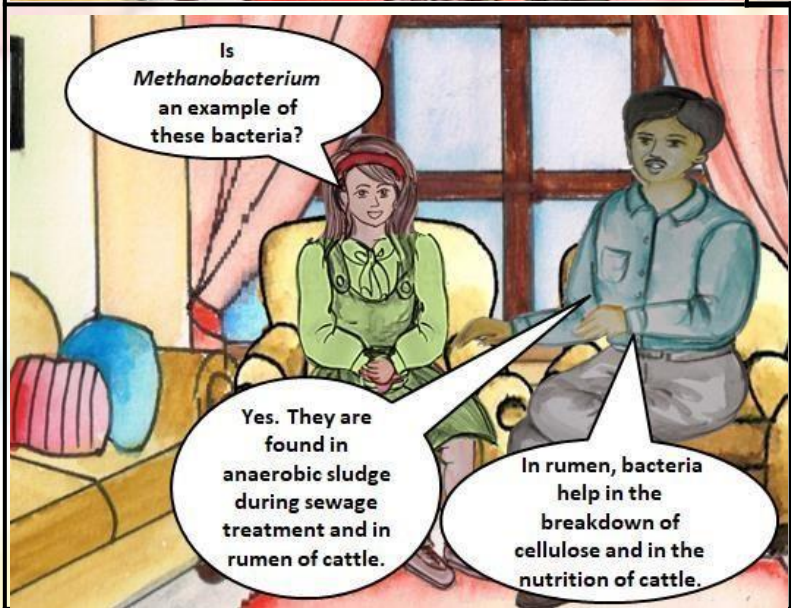
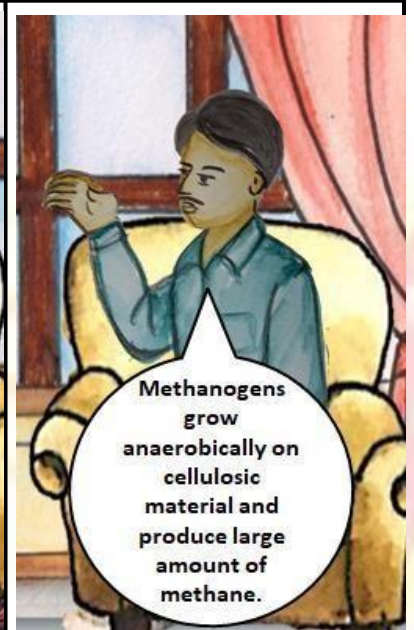
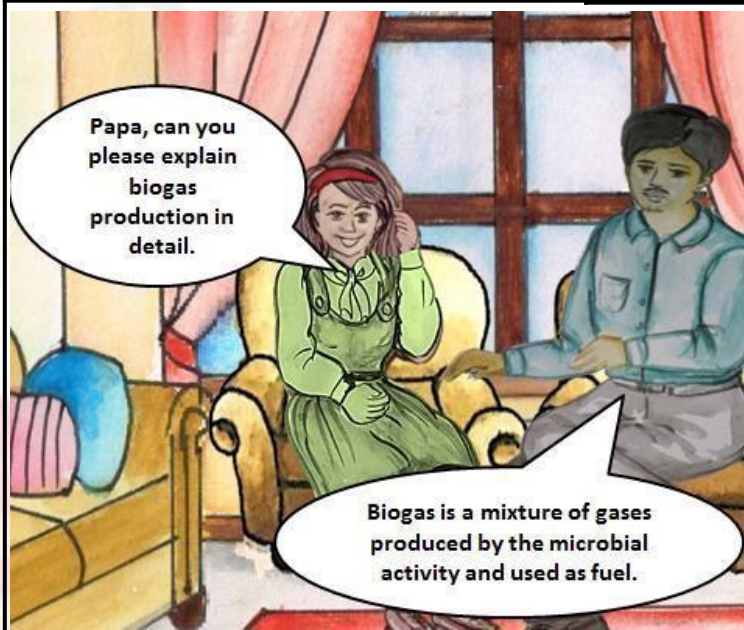


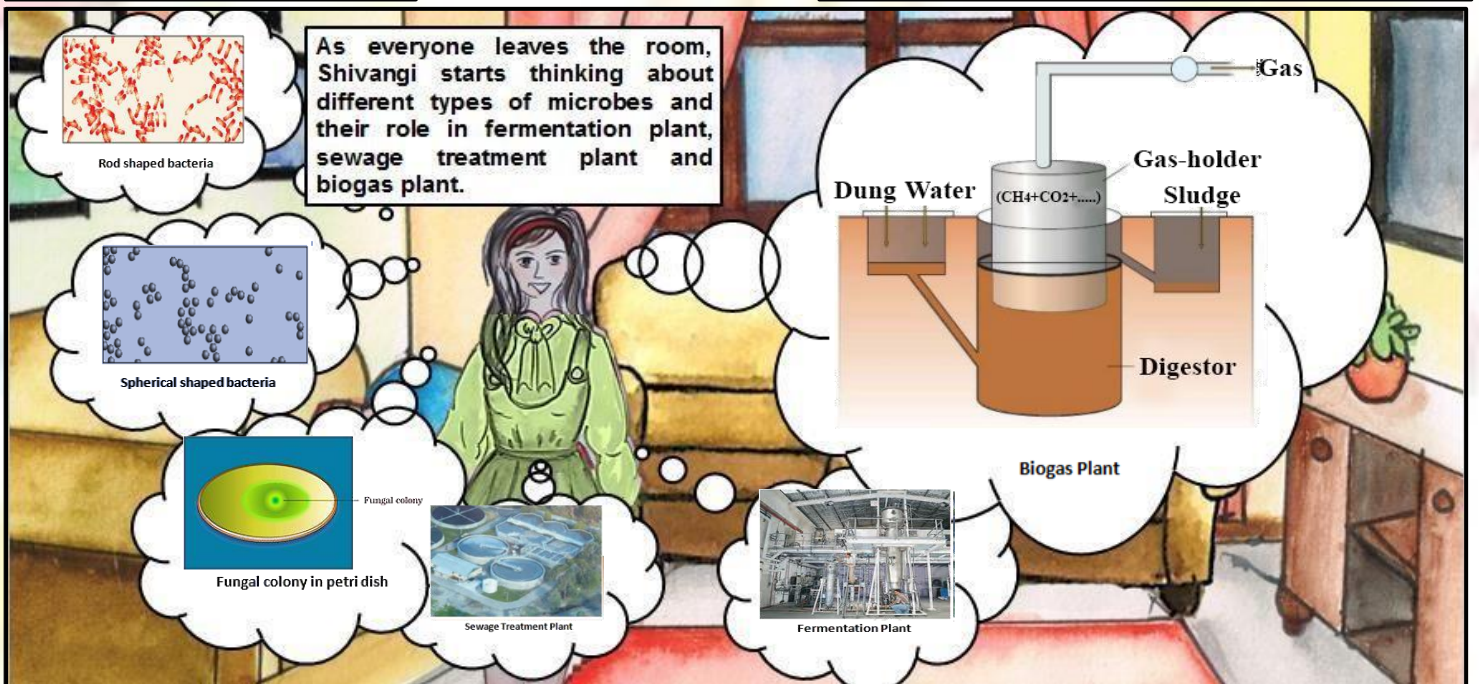
Statins produced by *Monascus purpureus* (yeast) have been commercialised as blood-cholesterol lowering agents.

It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.









? Question Time

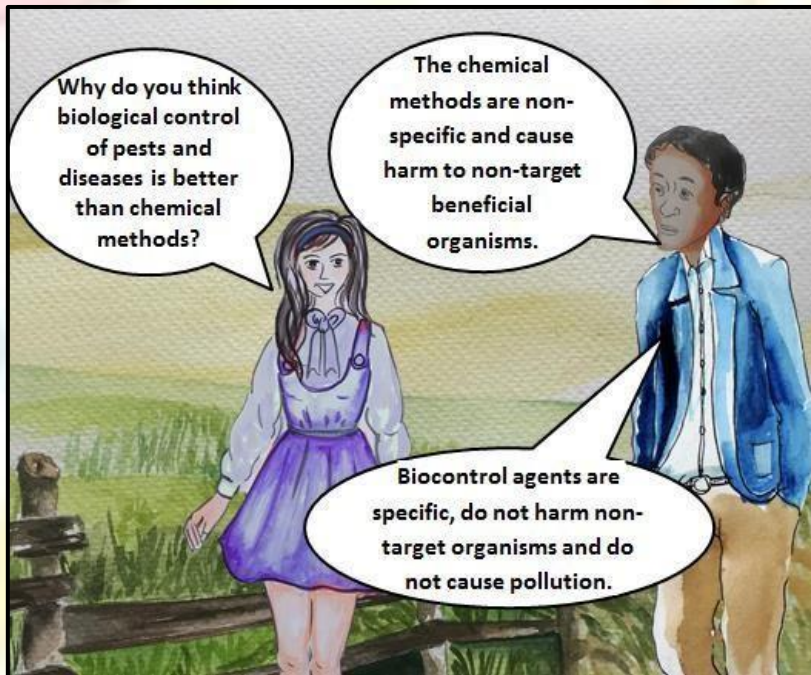
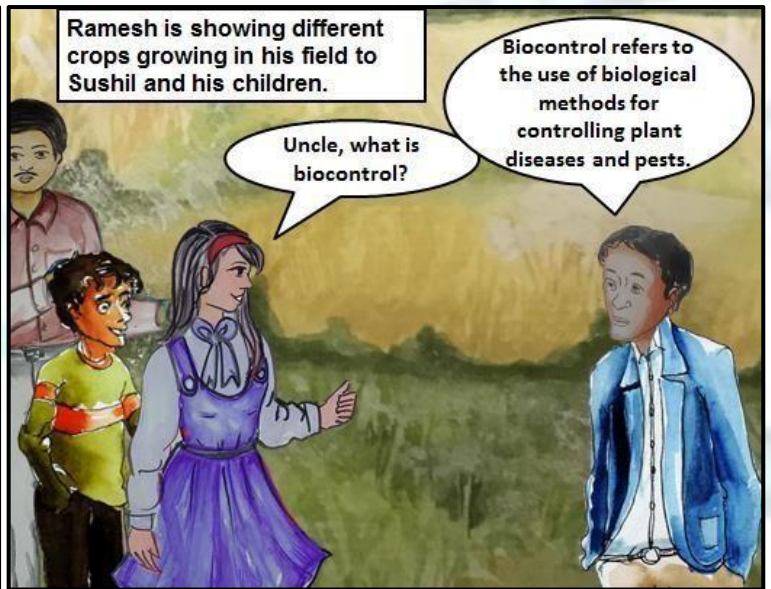
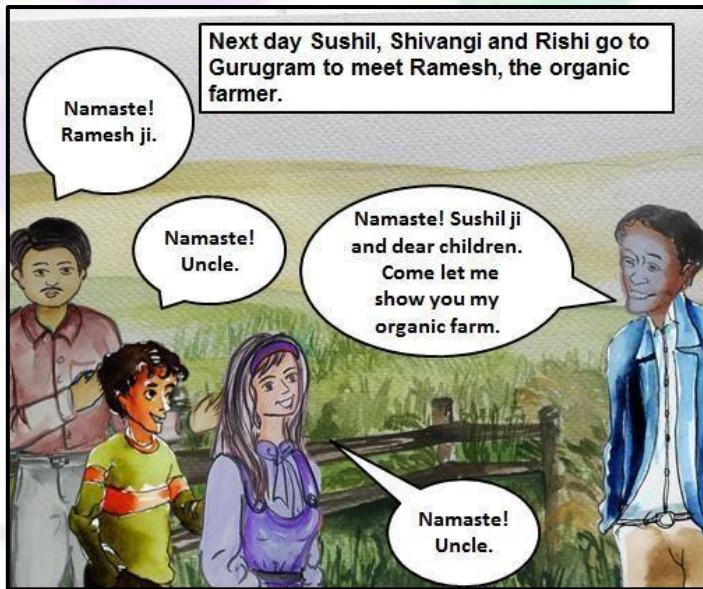
A. Choose the correct option:

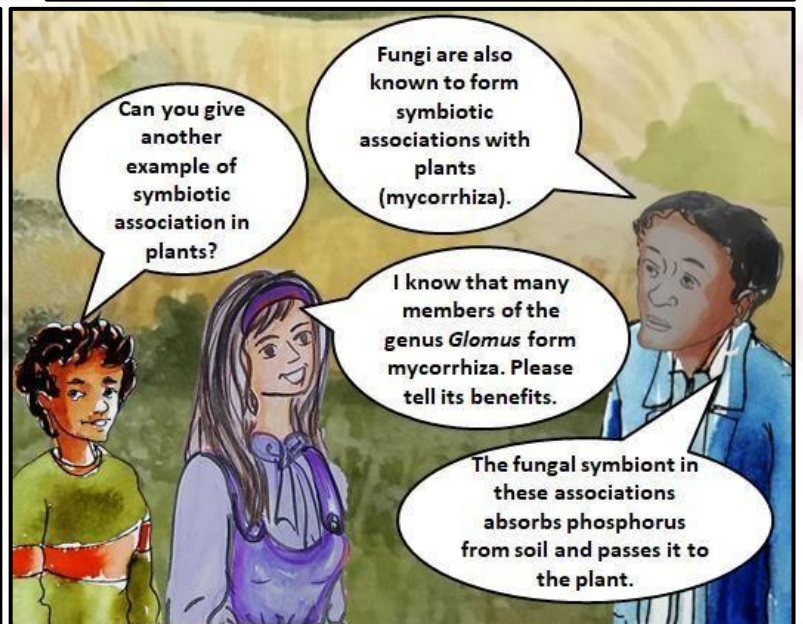
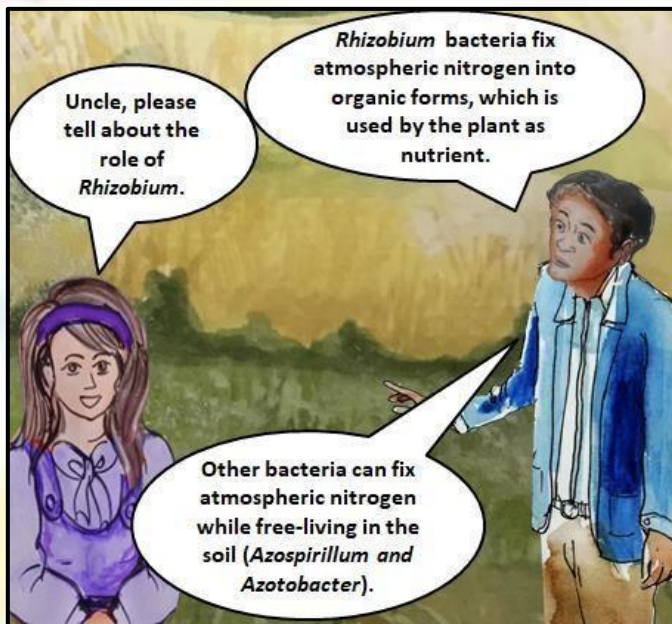
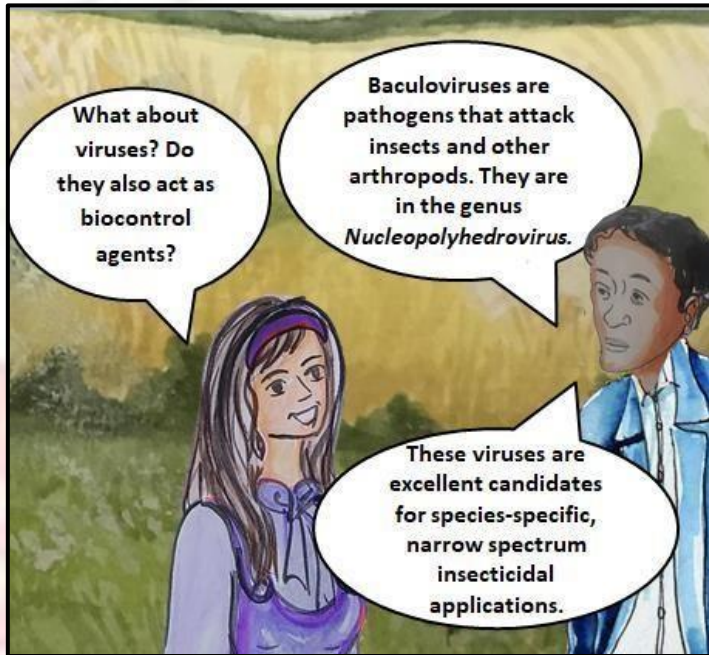
- During curd formation by lactic acid bacteria the nutritional quality improves due to increase in:
(a) Vitamin C (b) Vitamin D
(c) Vitamin B12 (d) Vitamin E
- Methanogenic bacteria are not found in
(a) rumen of cattle (b) gobar gas plant
(c) bottom of water-logged paddy fields (d) activated sludge
- Which one of the following alcoholic drinks is produced without distillation?
(a) Wine (b) Whisky
(c) Rum (d) Brandy
- BOD of waste water is estimated by measuring the amount of
(a) total organic matter (b) biodegradable organic matter
(c) oxygen evolution (d) oxygen consumption
- Waste water treatment generates a large quantity of sludge, which can be treated by
(a) anaerobic digesters (b) flocs
(c) chemicals (d) oxidation pond
- The primary treatment of waste water involves the removal of
(a) dissolved impurities (b) solid particles
(c) toxic substances (d) harmful bacteria
- The technology of biogas production from cow dung was developed in India largely due to the efforts of
(a) Gas Authority of India
(b) Oil and Natural Gas Commission
(c) Indian Agricultural Research Institute and Khadi and Village Industries Commission
(d) Indian Oil Corporation
- The yeast that is used in alcohol production and bread making is:
(a) *Escherichia coli* (b) *Saccharomyces cerevisiae*
(c) *Cryptococcus albidus* (d) *Candida albicans*
- What would happen if oxygen availability to activated sludge flocs is reduced?
(a) It will slow down the rate of degradation of organic matter.
(b) The centre of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.
(c) Flocs would increase in size as anaerobic bacteria would grow around flocs.
(d) Protozoa would grow in large numbers.
- Activated sludge should have the ability to settle quickly so that it can:
(a) be rapidly pumped back from sedimentation tank to aeration tank.
(b) absorb pathogenic bacteria present in waste water while sinking to the bottom of the settling tank.
(c) be discarded and anaerobically digested.
(d) absorb colloidal organic matter.

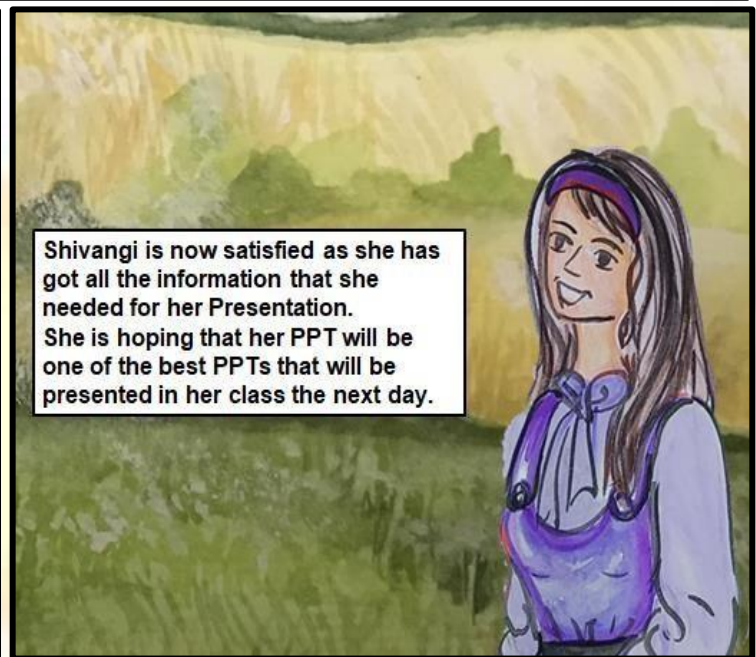
B. Match the following list of bacteria and their commercially important products:

BACTERIUM	PRODUCT
(a) <i>Aspergillus niger</i>	(i) Lactic acid
(b) <i>Acetobacter aceti</i>	(ii) Butyric acid
(c) <i>Clostridium butylicum</i>	(iii) Acetic acid
(d) <i>Lactobacillus</i>	(iv) Citric acid

Story- Microbes in Human Welfare (contd.)



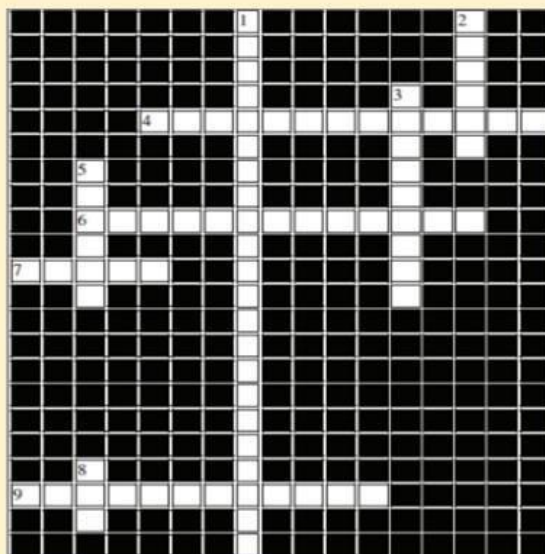




CROSSWORD



Puzzle Time



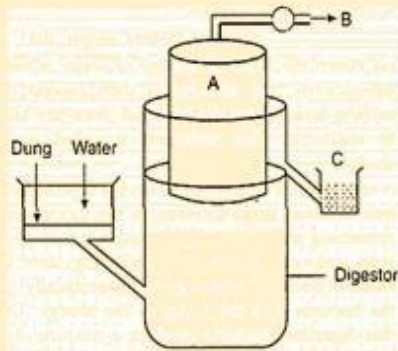
Across

- 4 produced by *Trichoderma polysporum*
- 6 clot buster
- 7 mass of bacteria and fungal filaments
- 9 free living biofertilisers

Down

- 1 first biological pesticide
- 2 proteinaceous infecting agent
- 3 to clarify bottled fruit juices
- 5 biofertiliser
- 8 impurity of waste water

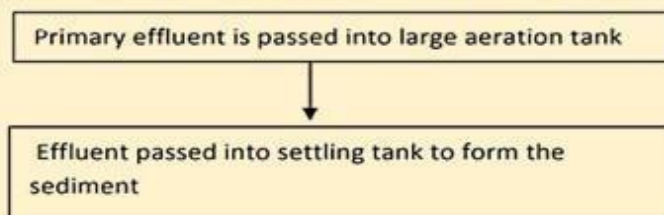
Question Time



1. Given below is a figure of a biogas plant.

- Identify A and ascertain its floating nature.
- Examine the products B and C and determine their significance.

2. Large quantities of sewage are generated everyday in cities and towns, which is treated in Sewage Treatment Plants (STPs) to make it less polluted. Given below is the flow diagram of one of the stages of STP. Observe the given flow diagram and answer the questions accordingly.



- Why primary effluent is passed into large aeration tanks?
- Write the technical term used for the sediment formed? Mention its significance.
- Explain the final step that results in the formation of biogas in the large tank before the treated effluent is released into water bodies.

3. Read the paragraph given below and answer the questions that follow:

Microbial biological control agents (MBCAs) are applied to crops for biological control of plant pathogens where they act via a range of modes of action. Some MBCAs interact with plants by inducing resistance or priming plants without any direct interaction with the targeted pathogen. Other MBCAs act via nutrient competition or other mechanisms modulating the growth conditions for the pathogen. Antagonists acting through hyperparasitism and antibiosis are directly interfering with the pathogen. Such interactions are highly regulated cascades of metabolic events, often combining different modes of action. Compounds involved such as signaling compounds, enzymes and other interfering metabolites are produced in situ at low concentrations during interaction. The potential of microorganisms to produce such a compound in vitro does not necessarily correlate with their in-situ antagonism. Understanding the mode of action of MBCAs is essential to achieve optimum disease control.

- Why should biological control of pests and pathogens be preferred to the conventional use of chemical pesticides?
- How are baculoviruses and *Bacillus thuringiensis* used as biocontrol agents?

GLOSSARY

- **Biofertilisers:** Microorganisms which produce fertilisers and enrich the soil e.g., bacteria, cyanobacteria and fungi.
- **Bioactive Molecules:** Molecules produced for commercial use from microbes and used for various purposes.
- **Biological Oxygen Demand (BOD):** Total amount of oxygen consumed by bacteria for oxidation of organic matter present in one litre of water.
- **Baculoviruses:** Pathogens that attack insects and other arthropods. They are used to kill harmful pests and arthropods.
- **Effluent:** The product of primary treatment of sewage.
- **Fermentors:** A very large vessel where microbes are grown on an industrial scale.
- **Flocs:** During secondary treatment of effluent, excessive growth of aerobic bacteria and fungi form a mass of mesh like structures called flocs.
- **Immunosuppressive Agent:** Chemicals which suppress the immunity against organ transplant.
- **Organic Farming:** Technique of farming, in which biofertilisers are used to enrich the soil, without using chemical fertilisers and pesticides to reduce their harmful effect on human health.
- **Biological Control:** Reduction of pest population by natural enemies minimising the use of harmful chemical pesticides.
- **Thermal vents:** The sites deep inside the geysers/hot springs and oceans where the average temperature is as high as 100°C.
- **Methanogens:** Bacteria producing large quantity of methane during decomposition of organic matter.

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DISCLAIMER

This Novel is published as a supportive reading material to enable the students to have a better understanding of the topic. The Characters used in this Graphic Novel are fictional and resemblance of any character or incident is merely a coincidence. Art work is done by students and teachers.

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FROM THE PRINCIPAL'S DESK

Dear readers,

'Change is the only constant', so said a wise man from the past. And so true indeed! With the coming of the National Education Policy 2020, the focus of education is shifting to more student centric education, and thus the need to produce the content in a way which can be easily understood by the students.

The Central Board of Secondary Education has also brought in alterations in the way education was being imparted in the classrooms of the nation. Art Integration with the curriculum, competency based education, stress on Physical Fitness are all endeavours to prepare the students for the necessities of the future. One such endeavour is also changing the curriculum to graphic novels.

Conceived and directed by Mr. Sandeep Sethi, his passion rubbed on to the teachers as well. He lent support through constant guidance.

I am also grateful to Ms. Anita Karwal, Secretary, Department of School Education, Ministry of Human Resource and Development, whose valuable inputs and constant motivation has encouraged teachers to curate the concepts in the form of interesting graphics. I am very sure that this will change the way topics are taught in the classrooms. Using comic strip as a tool, concepts will be explained in a simple way, more relatable to the students.

Our sincere thanks to the worthy team of Ms. Anita Karwal, Secretary, Department of School Education, Ministry of Human Resource and Development, Mr. Manoj Ahuja, Chairman, Central Board of Secondary Education and Mr. Sandeep Sethi, the pilot of the project.

My sincere thanks are also due to the team of gifted teachers and students who in a time-bound frame produced creatively endowed content which will be a visual extravaganza for the students.

Enjoy reading!

Mallika Preman

Principal

SUMMARY

Microbes are a very important component of life on earth. Not all microbes are pathogenic. Many microbes are very useful for human beings. We use microbes and microbially derived products almost every day.

Bacteria called lactic acid bacteria (LAB) grow in milk to convert it into curd. The dough, which is used to make bread, is fermented by yeast called *Saccharomyces cerevisiae*. Certain dishes such as idli and dosa, are made from dough fermented by microbes.

Bacteria and fungi are used to impart particular texture, taste and flavor to cheese. Microbes are used to produce industrial products like lactic acid, acetic acid and alcohol, which are used in a variety of processes in the industry. Antibiotics like penicillin produced by useful microbes are used to kill disease-causing harmful microbes.

Antibiotics have played a major role in controlling infectious diseases like diphtheria, whooping cough and pneumonia. For more than a hundred years, microbes are being used to treat sewage (waste water) by the process of activated sludge formation and this helps in recycling of water in nature.

Methanogens produce methane (biogas) while degrading plant waste. Biogas produced by microbes is used as a source of energy in rural areas. Microbes can also be used to kill harmful pests, a process called as biocontrol.

The biocontrol measures help us to avoid heavy use of toxic pesticides for controlling pests. There is a need these days to push for use of biofertilisers in place of chemical fertilisers. It is clear from the diverse uses human beings have put microbes to that they play an important role in the welfare of human society.

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