

Our Environment

Class 10 - CBSE Science | Chapter 13 | Worksheet & Test Paper

15 MCQs | 8 board questions | 7 practice problems

Video lesson, notes and an interactive quiz: learn.ultimatetools.io

SECTION A - Multiple Choice Questions (1 mark each)

1. Which of the following groups contains only biodegradable items?

- (a) Fruit peels, cake and lime juice
- (b) Grass, flowers and polythene
- (c) Cake, wood and aluminium foil
- (d) Grass, wood and plastic

2. Which of the following constitutes a food chain?

- (a) Grass, wheat and mango
- (b) Grass, goat and human
- (c) Goat, cow and elephant
- (d) Grass, fish and goat

3. The organisms that break down dead remains and waste products into simple substances are called:

- (a) producers
- (b) herbivores
- (c) decomposers
- (d) top carnivores

4. In the food chain grass → grasshopper → frog → snake, the frog occupies which trophic level?

- (a) The fourth
- (b) The first
- (c) The second
- (d) The third

5. According to the ten per cent law, if the producers in an ecosystem capture 10,000 J of energy, the energy available to the secondary consumers is about:

- (a) 100 J
- (b) 10 J
- (c) 5000 J
- (d) 1000 J

6. Food chains generally consist of only three or four steps because:

- (a) the number of species in nature is limited
- (b) very little usable energy remains after four trophic levels
- (c) decomposers break the chain after the fourth level
- (d) the producers cannot support more than four consumers

7. The flow of energy in an ecosystem is said to be unidirectional because:

- (a) energy flows equally in both directions along the chain
- (b) energy is stored permanently by the decomposers
- (c) energy flows from the producers onwards and never returns
- (d) energy is created afresh at every trophic level

8. In an ecosystem, the greatest number of individuals is generally found among the:

- (a) top carnivores
- (b) secondary consumers
- (c) herbivores
- (d) producers

9. The progressive increase in the concentration of harmful chemicals at each successive trophic level is called:

- (a) biological magnification
- (b) biodegradation by microbes
- (c) depletion of the ozone layer

(d) eutrophication of lakes

10. In a food chain water -> plants -> small fish -> large fish -> human, the maximum concentration of pesticide will be found in the:

- (a) small fish
- (b) human
- (c) water
- (d) plants

11. Ozone is:

- (a) a mixture of oxygen and nitrogen
- (b) a molecule of two oxygen atoms
- (c) a molecule of three oxygen atoms
- (d) an atom of oxygen with three electrons

12. Which statement about ozone is correct?

- (a) It is completely harmless at every level of the atmosphere
- (b) It is found only at the surface of the earth
- (c) It is essential for breathing at ground level
- (d) It is a poison at ground level but a shield high up

13. The ozone layer protects us from ultraviolet radiation, which in human beings is known to cause:

- (a) skin cancer
- (b) night blindness
- (c) goitre
- (d) anaemia

14. The depletion of the ozone layer is caused mainly by:

- (a) carbon dioxide from vehicles
- (b) chlorofluorocarbons (CFCs)
- (c) sulphur dioxide from factories
- (d) methane from paddy fields

15. The agreement to freeze CFC production at 1986 levels was forged in 1987 by:

- (a) the Food and Agriculture Organization
- (b) the World Health Organization (WHO)
- (c) the United Nations Environment Programme
- (d) the International Atomic Energy Agency

SECTION B - Board-style Questions

1. What is an ecosystem? Name its two kinds of components with two examples of each, and distinguish between a natural and an artificial ecosystem. [5 marks]

2. Name the three functional groups of organisms in an ecosystem and state the role of each. What would happen to the ecosystem if all the decomposers were removed? [5 marks]

3. What is a trophic level? Give an example of a food chain and state the different trophic levels in it. Why is the flow of energy in an ecosystem said to be unidirectional? [5 marks]

4. State the ten per cent law. If the producers of an ecosystem receive 20,000 J of energy from the Sun, calculate the energy available to the tertiary consumers, and explain why food chains rarely have more than four steps. [5 marks]

5. Distinguish between a food chain and a food web. Why does a food web make an ecosystem more stable than a set of separate food chains would? [3 marks]

6. What is biological magnification? Explain how pesticides sprayed on crops end up in the human body, and state why human beings are the worst affected. [5 marks]

7. What is ozone and how is it formed in the upper atmosphere? Why is it described as both a deadly poison and an essential shield? [5 marks]

8. What are CFCs and how do they affect the ozone layer? Describe the international step taken in 1987 to control the problem. [3 marks]

SECTION C - Practice Problems

1. A student says: 'An aquarium in my classroom is not really an ecosystem, because people made it.' Assess this claim, and state clearly what an aquarium would need in order to qualify.

Hint: Check the definition of an ecosystem - does it say anything about who made it?

2. In a food chain the producers capture 100,000 J of energy. Calculate the energy available at each of the next three trophic levels, name the trophic level of each, and use your answer to explain why a FIFTH trophic level is so rarely found in nature.

Hint: Apply the 10% law once for each transfer, and number the levels as you go.

3. Two ponds are sprayed with the same amount of a non-biodegradable pesticide. In pond A the pesticide is measured in the water; in pond B it is measured in the large fish that live there. Predict which measurement will be higher and explain the reasoning in full.

Hint: Follow the chemical from the water into the organisms, and ask what happens to it at each step.

4. Explain why the ozone found near the ground is regarded as a pollutant while the ozone high in the atmosphere is regarded as essential. Include how the high-level ozone is formed.

Hint: The molecule is identical in both places - what differs is where it is and what it does there.

5. A family fills two pits with waste: pit 1 with vegetable peels, paper and cotton rags, and pit 2 with plastic bags, glass bottles and aluminium foil. Both are covered with soil and opened after six months. Describe and explain what they will find in each pit.

Hint: Which pit contains material that decomposers can act on?

6. Give one reason why each of the following is a poor way to dispose of household waste: (a) burning plastic in the open, (b) throwing all waste into one bin, (c) dumping waste into a river.

Hint: For each, ask what happens to the material afterwards and who is affected.

7. A farmer sprays a large amount of DDT on his field to kill insects. Trace what happens to the DDT afterwards, and explain why birds of prey nesting near the field are harmed even though none of the DDT was sprayed on them.

Hint: Follow the chemical step by step up the food chain that starts in that field.

ANSWER KEY

Our Environment - Class 10 CBSE Science

Section A - MCQ answers

1. (a) Fruit peels, cake and lime juice

Fruit peels, cake and lime juice are all broken down by bacteria and other decomposers. Plastic, polythene and aluminium foil are non-biodegradable, so any group containing them is ruled out.

2. (b) Grass, goat and human

A food chain needs organisms feeding on one another in a series: grass (producer) → goat (herbivore) → human. Grass, wheat and mango are all producers; goat, cow and elephant are all herbivores; and a fish does not eat grass on land nor is it eaten by a goat.

3. (c) decomposers

Decomposers - bacteria and fungi - break down dead organisms and waste, returning the nutrients to the soil where plants can use them again. Without them the cycling of materials in nature would stop.

4. (d) The third

Grass is the producer and the 1st trophic level, the grasshopper is the primary consumer at the 2nd, and the frog is the secondary consumer at the 3rd. The snake is a tertiary consumer at the 4th.

5. (a) 100 J

Producers 10,000 J → primary consumers get 10% = 1000 J → secondary consumers get 10% of that = 100 J. Only about a tenth passes on at each step, the rest being used up in life processes and lost as heat.

6. (b) very little usable energy remains after four trophic levels

Only about 10% of the energy passes to each successive level, so the loss at each step is very large. After four trophic levels so little usable energy is left that a further level cannot be supported.

7. (c) energy flows from the producers onwards and never returns

Energy captured by producers does not revert to the Sun, and energy passed on to herbivores does not go back to the plants. It moves in one direction only, decreasing at each step.

8. (d) producers

There are generally more individuals at the lower trophic levels, and the greatest number of all is that of the producers - which follows directly from the large loss of energy at each step.

9. (a) biological magnification

Pesticides and similar chemicals are neither broken down nor excreted, so they accumulate and become more concentrated at every step of the food chain. This is biological magnification.

10. (b) human

Because the concentration rises at every trophic level, the organism at the TOP of the chain accumulates the most. Human beings occupy the top of most food chains, so the maximum concentration ends up in us.

11. (c) a molecule of three oxygen atoms

Ozone is O₃, a molecule made of three atoms of oxygen. The oxygen we breathe is O₂, made of two atoms.

12. (d) It is a poison at ground level but a shield high up

At ground level ozone is a deadly poison. High in the atmosphere, however, it performs an essential function by shielding the earth from the Sun's ultraviolet radiation.

13. (a) skin cancer

UV radiation is highly damaging to living organisms and is known to cause skin cancer in human beings. That is why the depletion of the ozone layer is a serious concern.

14. (b) chlorofluorocarbons (CFCs)

CFCs - man-made chemicals used in refrigerators and fire extinguishers - reach the upper atmosphere and break ozone down. Carbon dioxide and methane are greenhouse gases, a different environmental problem.

15. (c) the United Nations Environment Programme

In 1987 UNEP succeeded in forging an agreement to freeze CFC production at 1986 levels. It is now mandatory for manufacturing companies worldwide to make CFC-free refrigerators.

Section B - Model answers

1. What is an ecosystem? Name its two kinds of components with two examples of each, and distinguish between a natural and an artificial ecosystem.

AN ECOSYSTEM is all the interacting organisms in an area together with the non-living constituents of the environment. ITS TWO KINDS OF COMPONENTS: (1) BIOTIC components - all the living organisms, for example plants and animals (also fungi and bacteria); (2) ABIOTIC components - the physical, non-living factors, for example temperature and rainfall (also wind, soil and minerals). NATURAL vs ARTIFICIAL: a NATURAL ecosystem is one that exists in nature and maintains itself without human help - for example a forest, a pond or a

lake. An ARTIFICIAL (man-made) ecosystem is created and maintained by human beings - for example a garden, a crop field or an aquarium. A garden qualifies as an ecosystem because the plants and animals in it interact with one another, and their growth and reproduction are affected by abiotic factors such as the soil and the weather.

2. Name the three functional groups of organisms in an ecosystem and state the role of each. What would happen to the ecosystem if all the decomposers were removed?

THE THREE GROUPS: (1) PRODUCERS - all green plants and blue-green algae. They make their own food from sunlight by photosynthesis, and ALL the energy entering the ecosystem enters through them. (2) CONSUMERS - organisms that depend on producers directly or indirectly for food; they are herbivores, carnivores, omnivores or parasites. (3) DECOMPOSERS - bacteria and fungi, which break down the dead remains and waste products of organisms into simple substances. IF ALL DECOMPOSERS WERE REMOVED: the dead bodies of plants and animals, and all waste products, would keep piling up in the environment, since nothing would break them down. More seriously, the nutrients locked up inside those dead remains would NEVER be returned to the soil. The producers would therefore be deprived of the raw materials they need, and the cycling of materials in nature would come to a halt - so the whole ecosystem would eventually collapse.

3. What is a trophic level? Give an example of a food chain and state the different trophic levels in it. Why is the flow of energy in an ecosystem said to be unidirectional?

A TROPHIC LEVEL is each step, or level, of a food chain at which the transfer of food (and hence of energy) takes place. EXAMPLE OF A FOOD CHAIN: GRASS → GRASSHOPPER → FROG → SNAKE. THE TROPHIC LEVELS: grass is the PRODUCER and occupies the FIRST trophic level; the grasshopper is a herbivore, or primary consumer, at the SECOND; the frog is a secondary consumer at the THIRD; and the snake is a tertiary consumer at the FOURTH. WHY THE FLOW IS UNIDIRECTIONAL: the energy captured by the producers from the Sun does not revert to the Sun, and the energy that passes to the herbivores does not go back to the plants. Energy moves in one direction only, from producers to consumers, and it decreases sharply at each step because a large part is used up in life processes and lost as heat.

4. State the ten per cent law. If the producers of an ecosystem receive 20,000 J of energy from the Sun, calculate the energy available to the tertiary consumers, and explain why food chains rarely have more than four steps.

THE TEN PER CENT LAW: an average of only 10% of the food eaten by an organism at one trophic level is turned into its own body and made available to the next level of consumers; the remaining 90% is used up in its own life processes and is largely lost as heat. CALCULATION: producers = 20,000 J. Primary consumers (herbivores) receive 10% of 20,000 = 2000 J. Secondary consumers receive 10% of 2000 = 200 J. TERTIARY CONSUMERS receive 10% of 200 = 20 J. So only 20 J of the original 20,000 J is available to the tertiary consumers. WHY CHAINS ARE SHORT: because the loss at each step is so great, the energy remaining after three or four transfers is extremely small. After four trophic levels there is too little usable energy left to support a further level, so food chains generally consist of only three or four steps.

5. Distinguish between a food chain and a food web. Why does a food web make an ecosystem more stable than a set of separate food chains would?

A FOOD CHAIN is a SINGLE, straight-line series of organisms in which each one is eaten by the next, for example grass → grasshopper → frog → snake. A FOOD WEB is the NETWORK formed when many such food chains cross and interconnect. In nature each organism is generally eaten by two or more different kinds of organism, and itself feeds on more than one kind, so the straight chains do not stay separate - they interlink into a web. WHY A WEB GIVES STABILITY: because each organism has ALTERNATIVE sources of food. If one species becomes scarce or disappears, the animals that fed on it can turn to other prey, so the ecosystem absorbs the change instead of collapsing. In a single isolated food chain, the loss of one link would break the entire chain.

6. What is biological magnification? Explain how pesticides sprayed on crops end up in the human body, and state why human beings are the worst affected.

BIOLOGICAL MAGNIFICATION is the progressive INCREASE in the concentration of harmful chemicals at each successive trophic level of a food chain. HOW PESTICIDES REACH US: pesticides are sprayed on crops to protect them from pests. These chemicals are washed down into the soil, and also into water bodies. From the soil and the water they are ABSORBED BY PLANTS along with water and minerals, and from the water they are taken up by aquatic organisms. They then pass from one trophic level to the next along the food chain. Because these chemicals are NOT broken down by biological processes and are NOT excreted from the body, they are stored and become MORE CONCENTRATED at every step. WHY HUMANS ARE WORST AFFECTED: human beings occupy the TOP of most food chains, so the maximum concentration of these chemicals accumulates in our bodies. This is why our food grains, vegetables, fruits and even meat contain pesticide residues, which cannot always be removed by washing or other means.

7. What is ozone and how is it formed in the upper atmosphere? Why is it described as both a deadly poison and an essential shield?

OZONE is a molecule made up of THREE atoms of oxygen, written O₃ - unlike the oxygen we breathe, which is O₂. HOW IT IS FORMED: high-energy ULTRAVIOLET (UV) radiation from the Sun splits an oxygen molecule into two free oxygen atoms: O₂ → O + O. Each of these free oxygen atoms then combines with another oxygen molecule to form ozone: O + O₂ → O₃. BOTH POISON AND SHIELD: at GROUND level ozone is a DEADLY POISON, harmful to living organisms. But at the HIGHER levels of the atmosphere it performs an essential function - it SHIELDS the surface of the earth from the ultraviolet radiation of the Sun. This UV radiation is highly

damaging to organisms and is known to cause SKIN CANCER in human beings, so without the ozone layer life on the earth's surface would be seriously harmed.

8. What are CFCs and how do they affect the ozone layer? Describe the international step taken in 1987 to control the problem.

CFCs are CHLOROFLUOROCARBONS - man-made chemicals that were widely used in REFRIGERATORS and in FIRE EXTINGUISHERS. HOW THEY AFFECT THE OZONE LAYER: when CFCs are released they rise into the upper atmosphere, where they BREAK OZONE DOWN. As a result the amount of ozone in the ozone layer began to drop sharply from the 1980s, which allows more of the Sun's harmful ultraviolet radiation to reach the earth's surface. THE INTERNATIONAL STEP: in 1987 the UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP) succeeded in forging an agreement to FREEZE CFC PRODUCTION at 1986 LEVELS. As a result it is now mandatory for all manufacturing companies throughout the world to make CFC-free refrigerators.

Section C - Solutions

1. A student says: 'An aquarium in my classroom is not really an ecosystem, because people made it.' Assess this claim, and state clearly what an aquarium would need in order to qualify.

The claim is WRONG. An ecosystem is defined as all the interacting organisms in an area TOGETHER WITH the non-living constituents of their environment - the definition says nothing about whether it arose naturally. An aquarium contains BIOTIC components (fish, aquatic plants, snails, and the bacteria in the gravel) and ABIOTIC components (water, temperature, light, dissolved minerals), and the organisms in it interact with one another and are affected by those physical factors. So it IS an ecosystem - specifically an ARTIFICIAL, or man-made, ecosystem, in the same category as a garden or a crop field. The only difference from a natural ecosystem such as a pond or a lake is that an artificial one must be created and MAINTAINED by human beings - the aquarium needs someone to feed the fish, clean the water and control the temperature, whereas a lake looks after itself.

2. In a food chain the producers capture 100,000 J of energy. Calculate the energy available at each of the next three trophic levels, name the trophic level of each, and use your answer to explain why a FIFTH trophic level is so rarely found in nature.

APPLYING THE 10% LAW at each step, and naming the level each time: 1st TROPHIC LEVEL - the PRODUCERS - 100,000 J. 2nd TROPHIC LEVEL - the primary consumers (herbivores) - 10% of 100,000 = 10,000 J. 3rd TROPHIC LEVEL - the secondary consumers - 10% of 10,000 = 1000 J. 4th TROPHIC LEVEL - the tertiary consumers - 10% of 1000 = 100 J. So of the 100,000 J the producers captured, only 100 J - one thousandth - reaches the fourth level. WHY A FIFTH LEVEL IS RARE: a fifth trophic level would receive only 10% of that 100 J, which is about 10 J - one ten-thousandth of what the producers captured. So little usable energy remains that it cannot support a population of animals at that level. This is exactly what NCERT means by saying that food chains 'generally consist of only three or four steps', and it is also why the animals at the very top of a chain, such as a hawk or a lion, are always very few in number.

3. Two ponds are sprayed with the same amount of a non-biodegradable pesticide. In pond A the pesticide is measured in the water; in pond B it is measured in the large fish that live there. Predict which measurement will be higher and explain the reasoning in full.

The concentration measured in the LARGE FISH of pond B will be far HIGHER than that measured in the water of pond A, even though the same amount of pesticide was added to each. REASONING: the pesticide is non-biodegradable, so it is NOT broken down by biological processes, and it is NOT excreted by the organisms that take it in. It therefore accumulates in their bodies. The pesticide in the water is absorbed by aquatic plants and microscopic organisms; small fish eat large numbers of these and store all the pesticide from every one of them; large fish then eat many small fish and store all of THAT pesticide in turn. At each trophic level the chemical becomes more concentrated - this is BIOLOGICAL MAGNIFICATION. Since the large fish sit at a higher trophic level, they carry a far greater concentration than the water itself, which is where the chemical is most dilute.

4. Explain why the ozone found near the ground is regarded as a pollutant while the ozone high in the atmosphere is regarded as essential. Include how the high-level ozone is formed.

The molecule is exactly the same in both cases - O₃, three atoms of oxygen. What differs is its location and therefore its effect. AT GROUND LEVEL ozone is a DEADLY POISON: it is in direct contact with living organisms and damages them, so at this level it counts as a pollutant. HIGH IN THE ATMOSPHERE the same molecule is far away from living things and instead performs an essential function - it SHIELDS the surface of the earth from the ULTRAVIOLET radiation of the Sun, which is highly damaging to organisms and is known to cause skin cancer in human beings. HOW IT FORMS UP THERE: high-energy ultraviolet radiation splits an oxygen molecule into two free oxygen atoms (O₂ → O + O), and each free atom then combines with another oxygen molecule to form ozone (O + O₂ → O₃). So the very radiation the ozone layer protects us from is also what creates it.

5. A family fills two pits with waste: pit 1 with vegetable peels, paper and cotton rags, and pit 2 with plastic bags, glass bottles and aluminium foil. Both are covered with soil and opened after six months. Describe and explain what they will find in each pit.

PIT 1 will be found to contain little or nothing of the original material - the vegetable peels, paper and cotton rags will largely have DECOMPOSED into a dark, soil-like material. These substances are BIODEGRADABLE: they are broken down by biological processes, through the action of BACTERIA and other decomposers, and the nutrients they contained are returned to the soil. (This is exactly the principle of composting.) PIT 2 will be found

essentially UNCHANGED - the plastic bags, glass bottles and aluminium foil will look much as they did six months earlier. These substances are NON-BIODEGRADABLE: decomposers cannot act on them, so they are not broken down by biological processes and persist in the environment for a very long time, harming it. This is why non-biodegradable waste has to be dealt with by recycling or landfill rather than composting - and why reducing the amount we generate matters so much.

6. Give one reason why each of the following is a poor way to dispose of household waste: (a) burning plastic in the open, (b) throwing all waste into one bin, (c) dumping waste into a river.

(a) BURNING PLASTIC IN THE OPEN: plastic is non-biodegradable, and burning it does not remove it harmlessly - it releases poisonous gases into the air, which pollute the atmosphere and are harmful to breathe. (b) THROWING ALL WASTE INTO ONE BIN: mixing biodegradable with non-biodegradable waste means the biodegradable part can no longer be composted usefully, and the recyclable materials (paper, glass, metal) become contaminated and much harder to recover. SEGREGATING waste at source is what makes composting and recycling possible at all. (c) DUMPING WASTE INTO A RIVER: this pollutes the water, harming or killing the aquatic organisms that live in it. Non-biodegradable substances such as pesticides then enter the aquatic FOOD CHAIN, where they undergo BIOLOGICAL MAGNIFICATION and eventually reach human beings, who drink the water and eat the fish.

7. A farmer sprays a large amount of DDT on his field to kill insects. Trace what happens to the DDT afterwards, and explain why birds of prey nesting near the field are harmed even though none of the DDT was sprayed on them.

STEP 1: DDT sprayed on the crop is washed by rain and irrigation water into the SOIL, and from there into nearby water bodies. STEP 2: the crop plants ABSORB the DDT along with the water and minerals they take up, so it enters the plant tissue. STEP 3: herbivorous insects and small birds eat those plants and take in the DDT. Because DDT is NON-BIODEGRADABLE, it is neither broken down nor excreted - so every particle each animal consumes is STORED in its body. STEP 4: a bird of prey eats a large number of those smaller animals over its life, and inherits the DDT from every single one of them. Its own concentration therefore becomes far higher than that of its prey. This progressive increase at each trophic level is BIOLOGICAL MAGNIFICATION, and it explains why the birds of prey - at the TOP of the food chain and never sprayed directly - end up carrying the highest concentration of all and suffer the greatest harm.

