Sample of the IGCSE Science (Double Award) Course, from Biology Section 1

Topic 1

Characteristics of living things

Introduction

In this first topic you will find out about the characteristics of living things – how we know that some things are alive. You will also learn how living things are put into groups according to their structures.

You will probably need 1 hour to complete this topic.

Objectives

When you have completed this topic you should be able to:

- explain the characteristics common to living organisms
- explain how the variety of living organisms is classified into groups of similar organisms.

Characteristics of living things

What do all living things have in common? Activity 1 will help you to think about this.

Activity 1

(Allow 5 minutes)

Imagine that you are a visitor from another planet. You arrive in the middle of a busy town and see many things. You choose a two-legged thing (a human being), and a specialised box on wheels (a car), and take them back to your spaceship for further investigation. In the table below is a list of 'characteristics of living things' produced for use on Earth. Go through these and tick the characteristics that apply to each one.

	Characteristic	Human	Car
1	Capable of movement		
2	Uses energy from fuel/food		
3	Obtains or produces its own fuel/food		
4	Responds to environmental stimuli		
5	Eliminates waste products		
6	Grows		
7	Reproduces		

You should have ticked all seven characteristics for the human, but only 1, 2, 4 and 5 for the car (4: the moving parts of a car may not work as well in cold weather, the car may skid on oily or wet roads; 5: the car takes in and uses oxygen and releases exhaust gases). So the car could be considered alive if only a few of the characteristics are necessary for life, but in fact living things must have ALL these features.

It is a little more difficult to apply this checklist to plants because some of the characteristic are not as obvious. They do, however, still apply. For example, all plants respond to light (an environmental **stimulus**), usually by growing so that they bend towards it.

Activity 2

(Allow 10 minutes)

If you have any house plants, put one in an area with light coming from one direction only. (You could put a small plant in a box with one side missing.) Leave it for a few days and then look at it carefully.

What do you notice?

If you do not have house plants, sow a few seeds of cress or mustard on a damp piece of kitchen towel on a plate and put them in a box with

one side missing. These seeds germinate quickly so you can observe them as they grow over a few days. Remember to keep the kitchen towel moist.

What do you notice?

You should have found that the stems have grown so that they bend towards the light. The leaves may also have turned to face the light.

Plants are able to produce their own food from simple chemicals and the Sun's energy. You will learn more about this in Section 3. Like other organisms, plants use food to provide themselves with energy as they need it; this release of energy from food is called **respiration**.

The biological terms for the characteristics of all living things are:

- **movement** – the ability to move all or part of the organism
- respiration – the release of energy from food
- **nutrition** (feeding) – plants contain **chloroplasts** which use energy from light to make food (**photosynthesis**); animals get food by eating other organisms
- **sensitivity** or **irritability** – the ability to react to stimuli in the surroundings
- **excretion** – the removal of waste products from the body of the organism
- **homeostasis** (the control of internal conditions) – most living things can control conditions inside them to some extent
- **growth** – the growing of offspring to adult size
- **reproduction** – the production of offspring.

There is one type of organism that is not alive in the true sense. This is the **virus**. A virus is basically a length of genetic material surrounded by a protein coat. On its own it cannot do anything – it has to enter a **cell** (the smallest living unit) of another organism. Once inside, it takes over and 'programmes' the cell to produce more viruses. Eventually the cell bursts and the new viruses are free to infect further living things.

You will learn more about viruses in Topic 4 of this section.

Variety of living things

There are so many living organisms that it is helpful to think of them in groups. Everyone is able to tell the difference between a fish and a bird, even though there are hundreds of types of each. All the members of the fish group have certain characteristics, and it is by looking for these characteristics that we recognise the animal as a fish.

Activity 3

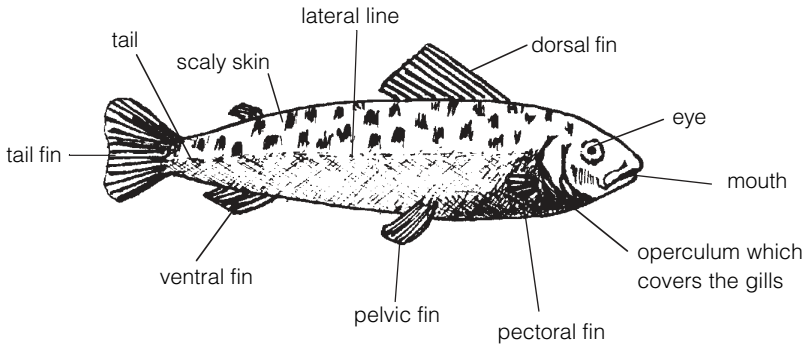
(Allow 5 minutes)

What would you say are the characteristics of a fish?

Fish have scaly skin, gills for gas exchange and fins to help them swim through the water.

If an animal has these features, then it is a fish. A dolphin has fin-like structures and it certainly swims like a fish, but it does not have gills and it doesn't have a scaly skin. It is therefore not a fish, but in fact is a mammal. Fish are 'cold-blooded'. This means that they cannot control their own temperature.

Figure 1.1 A trout



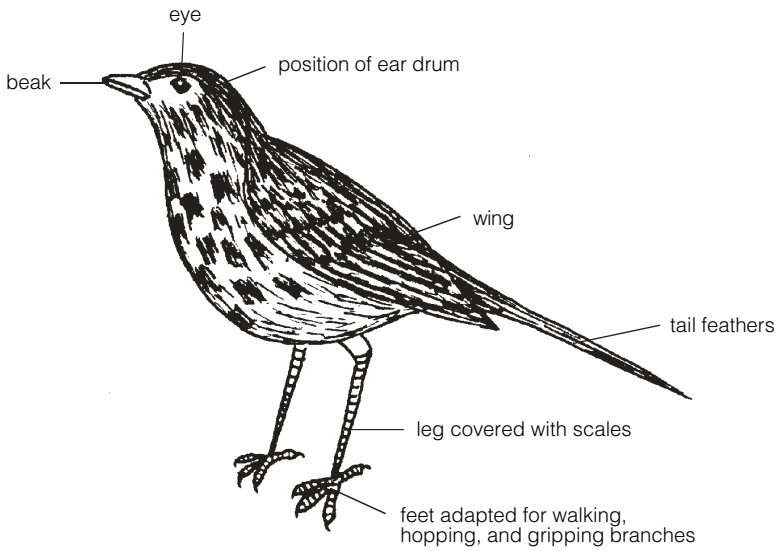
Activity 4

(Allow 5 minutes)

What are the characteristics of a bird?

Not all birds can fly, but they all have feathers and wings even if the wings are small and unsuitable for flying, as in the penguin. Birds have beaks formed from the upper and lower jaws. Beaks vary a lot as they are adapted to the feeding habits of each bird. All birds lay hard-shelled eggs. All birds are 'warm-blooded', which means that they can regulate and maintain a warm internal temperature.

Figure 1.2 A thrush



Living organisms are divided into five main groups or **kingdoms**:

1 **prokaryotes** (bacteria: simple single-celled organisms)

2 **protoctists** (more complex single-celled organisms)

3 **fungi**

4 plants

5 animals.

You will learn more about these different groups of organisms in Topics 2 to 4 of this section.

Each of these kingdoms is then divided into smaller groups, which may be subdivided again and again. Eventually we end up with a group whose members are structurally very similar. Members of this group are able to breed with one another to produce fertile offspring. This group is called a **species**.

Activity 5

(Allow 5 minutes)

The horse and the donkey can be bred together to produce a mule. A mule is sterile and cannot reproduce.

Do you think that the horse and the donkey are of the same or different species? Give a reason for your answer.

The horse and the donkey cannot produce fertile offspring because they belong to different species.

Different breeds of dog, such as spaniel, Alsatian, terrier, poodle, may look very different, but they can all interbreed to produce fertile mongrels. Therefore domestic dogs all belong to the same species.

Self check

(Allow 10 minutes)

Complete the following table by writing Y if a statement is correct or N if a statement is incorrect.

Characteristic	Animal	Plant	Virus
Grows			
Respires			
Makes its own food			
Eats ready-made food			
Reproduces			
Responds to stimuli			
Excretes			

You will find feedback to self checks at the end of the section.

Summary

In this topic you have been introduced to the diversity of living things. All living organisms have the same basic characteristics: movement, growth, nutrition, respiration, excretion, response to stimuli, maintaining constant internal conditions, and reproduction

Living things are organised into groups such as animals, plants, fungi, protoctists and bacteria.

In the next three topics you will learn more about the different groups of organisms, starting with animals and plants in Topic 2.

Key terms

cell: a microscopic component of a living organism; some organisms consist of one cell only, while others consist of large numbers of cells

chloroplast: a component of plant cells which uses light energy to convert simple substances into food

eukaryote (adjective: **eukaryotic**): an organism consisting of a cell or cells which have membrane-bound components (such as nucleus, chloroplasts)

excretion: the removal of the toxic waste products of metabolism, for example urea is removed via urine

fungi (singular **fungus**): eukaryotic organisms such as yeasts and moulds

growth: an increase in size/mass/number of cells in an organism

homeostasis: the regulation of internal conditions of an organism within set limits

irritability (**sensitivity**): the ability of an organism to perceive and respond to a stimulus

kingdom: one of the five main groups of living things (prokaryotes, protoctists, fungi, plants, animals)

movement: the ability to move all or part of the organism

nutrition: the taking in of nutrients such as organic substances and minerals

photosynthesis: the process in plants which occurs in chloroplasts, using energy in sunlight to produce food such as sugars

prokaryote (adjective **prokaryotic**): a single-celled organism which does not have membrane-bound components such as a nucleus, for example a bacterium

protoctists: a group of eukaryotic single-celled organisms

reproduction: the production of offspring by organisms

respiration: the release of energy from food substances within cells (which is available for use by the organism)

sensitivity: see **irritability**

species: a group of similar organisms which can breed together to produce fertile offspring

stimulus: something in the internal or external environment that produces a reaction in an animal or plant, e.g. light, temperature

virus: a very small particle that can only reproduce when inside living cells of specific types; a virus contains a strand of genetic material (DNA or RNA) surrounded by a protein coat

Going further

For a quick but informative overview of the characteristics of living things, go to:

IGCSE in 60 Seconds – Characteristics of living organisms (1:53), uploaded by Oh! I get it now 20 July 2013, accessed 11 April 2019 https://www.youtube.com/watch?v=HHsCgUQcw34