5) Hydrolytic enzymes – found in the spaces between cells. These include chitinases, which break down the chitin in fungal cell walls; glucanases, which hydrolyse the glycosidic bonds in glucans of bacterial walls; and lysosomes, which degrade bacterial cell walls.

(d) The primary non-specific defences against pathogens in animals

Non-specific defences to include skin, blood clotting, wound repair, inflammation, expulsive reflexes and mucous membranes (no detail of skin structure is required)

Animal defences against pathogens take 2 forms:

- 1) Primary defences which prevent entry of pathogens into the body
- 2) Secondary defences which combat pathogens that have already entered the body

Primary defences

The skin is the main primary defence against pathogens and parasites. It provides a barrier to the entry of microorganisms

Blood clothing and skin repair

Damage to the skin opens the body to infection. Blood clots reduced the loss arbiotecand make a temporary seal, preventing access by pathogens. Blood-clotting in Oves calcium ions and at least 12 other clotting factors that are released by plateled or from the damaged tissue. These factors activate an enzyme cascade, which proved cansoluble fibres. The clot dries out to form a scab. Over time, the scab shripte, on wing the sides of the cut cogether. Fibrous collagen is deposited under the scale and stem cells in the cuidelests divide to form new cells. These cells differentiate to form hew skin



Figure 1 Blood clotting.

Inflammation

Inflammation is the swelling and redness seen in infected tissues. Infected tissue often feels hot and tender. This is caused by a cell-signalling substance called histamine, Histamine is released from mast cells and it has a range of effects that act to help combat the infection. It causes vasodilation and makes the capillary walls more permeable to white blood cells and some proteins. More plasma enters the tissue fluid, causing oedema (Swelling). The excess tissue fluid is drained into the lymphatic system, moving the infecting pathogens towards the lymph nodes where the lymphocytes can initiate the specific immune response.

Mucous membranes

Any areas where the skin is incomplete are protected by mucous membranes. This includes the airways, lungs, digestive system, ears and genital areas; the epithelial layer contains mucus-secreting goblet cells. The mucus traps any pathogens, immobilising them. Some areas, such as the airways, also have ciliated cells. Cilia are tiny, hair-like organelles that can move in a coordinated fashion to waft the layer of mucus along.

Mucous membranes are sensitive to irritation. They respond to the presence of microorganisms or the toxins they release. This causes expulsive reflexes (e.g. coughing, sneezing and vomiting). In a cough or sneeze, the sudden expulsion of air carries with it the microorganism causing the irritation.



Figure 2 How a mucous membrane protects the body.

Biologists use biological classification of species to place living things into groups to make them easier to study. These groups are called taxonomic groups. The taxonomic hierarchy is shown below.

- Domain the domain is the highest taxonomic rank (see also topic 4.3.3). There are three domains: Archaea, Eubacteria and Eukaryotae.
- Kingdom traditionally there are five main kingdoms (see also topic 4.3.2). Plantae, Animalia, Fungi and Protoctista are all eukaryotes, which possess a nucleus. All those single-celled organisms that do not possess a nucleus are grouped into the kingdom Prokaryotae.
- Phylum a major subdivision of the kingdom. A phylum contains all the groups of organisms that have the same body plan, e.g. possession of a backbone.
- Class a group of organisms that all possess the same general traits, e.g. the same number of legs.
- Order a subdivision of the class using additional information about the organisms, e.g. the class mammal is divided or a meat-eating animals (order Carnivora) and regension-eating animals (order Herbivora).
- Family a group of closely related general, e.g. within the order Carnifora we might recognize to 'dog' family and the 'cat' family.
- Genus a group of closely related species.
- Species the basic unit of classification. All members of a species show some variations, but all are essentially the same.

(b) The binomial system of naming species and the advantage of such a system

The binomial system is the way in which we use two Latin words to name each species. The first name is the name of the genus to which the species belongs and the second name is the specific or species name. For example, in the term *Homo sapiens, homo* is the genus of man and *sapiens* is our species name. Both of the Latin names should always be written with an upper case first letter, whereas the species should be in lower case.

The main advantage of this system is to avoid the confusion that can arise if local names are used. The binomial system is recognised worldwide. Certain chemicals, such as DNA, proteins and RNA, are universal to all living things. Variation is caused by changes (mutations) in the DNA, which produced changes in proteins. As evolution occurs and one species becomes two, the DNA accumulates more changes, as does the structure of the proteins it codes for. Therefore, closely related species have similar DNA and proteins, but more distantly related species have DNA and proteins that are more different.

Sequencing the bases in DNA and the amino acids in proteins show the similarities and differences between species. This reveals their evolutionary relationships in the same way that similarities in anatomy and morphology reveal evolutionary relationships.

This evidence from biochemistry is, perhaps, more reliable and more convincing than that from fossils.

(f) The different types of variation

To include intraspecific and interspecific variation AND the differences between continuous and discontinuous variation, using examples of a range of characteristics found in plants, animals and microorganisms AND both genetic and environmental causes of variation.

An opportunity to use standard deviation to measure the spread of a set of data AND/OR student's t-test to compare means of data values of two populations AND/OR the Spearman's Notesale.co.uk rank correlation coefficient to consider the relationship of the data.

Variation is the differences that arise between living organisms.

Intraspecific and interspecific variation

Intraspecific variation occurs bet nese differences could be:

- Biochemical differences such as the precise sequence of amino acids in a protein
- Behavioural differences such as the type of food eaten

These differences are usually relatively minor, but they can be more obvious such as the differences between sexes.

Variation can also occur between members of different species (interspecific variation). This depends on how closely related one species is to the other:

- If the species are closely related, such as the lion and the tiger, the differences may not be great
- If the species are not closely related, the differences will be greater

Remember that variation is the key to evolution – variation must occur before any characteristic can become beneficial and selected for.

Continuous and discontinuous variation

Continuous variation is a variation that shows a complete range with no distinct groups