The **key areas** are from the Added Value Unit Specification. **Suggested learning activities** are not mandatory. This offers examples of suggested activities, from which you could select a range. It is not expected that all will be covered. The contexts for key areas are open to personalisation and choice, so centres are likely to devise their own learning activities. **Exemplification of key areas** is not mandatory. It provides an outline of the level of demand and detail of the key areas.

Cell Biology		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
1 Cell division and its role in growth and repair.	♦ Grow colonies of microorganisms on agar. ♦ Investigate the use of cells in the context of tissue culture for therapeutic use. ♦ Investigate regeneration of damaged tissues in organisms such as salamanders and starfish.	Cell division is essential to allow organisms to grow and repair damaged parts, eg cuts, broken bones. During cell division, the parent cell divides to produce two identical cells, which contain the same number of chromosomes in their nuclei as the parent cell. Cancer cells result from uncontrolled cell division.
2 DNA, genes and chromosomes.	♦ Decoding activities to produce coloured 'paper-chain' proteins. ♦ Case studies of inherited diseases.	Genes are located on chromosomes in the nucleus. Genes are made of DNA which carries the instructions to make proteins. Genes are passed on from parents to offspring. Each individual's DNA is unique.
3 Therapeutic use of cells.	♦ Investigate uses of genetic engineering. ♦ Investigate, eg insulin/factor VIII/human growth hormone. ♦ Research projects or visit research labs to see uses which are relevant.	Insulin or other protein production via genetic engineering. Other examples may include stem cell technology or using cells to grow artificial organs.
4 Properties of enzymes and their use in industries.	♦ Carry out experiments with, eg phosphorylase, amylase, catalase to demonstrate specificity and to test for substrates and products using iodine, Benedict's and Clinistix. ♦ Make paper/plasticine models or	Enzymes are found in living cells. They are specific, speed up reactions in cells and remain unchanged by the reaction. Enzymes build-up and break-down molecules. The actual mechanism of how they do this is not required. Enzymes can be used in a range of biotechnology industries.

Cell Biology		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
	animations of enzyme action. ♦ Investigate the cleaning effect or energy efficiency of biological and non-biological detergents. ♦ Carry out experiments with rennet. Make cheese/visit cheese factory. Investigate the history and ethics of rennet production.	
5 Properties of microorganisms and their use in industries.	♦ Make, eg bread, beer, yoghurt. ♦ Visit a local industry. ♦ Investigate production and use of biofuels. ♦ Investigate the effect of temperature on rising dough. ♦ Investigate breakdown of sewage. ♦ Use, eg nigrosin stain to visualise bacteria in yoghurt. ♦ Investigate use of microorganisms in bioremediation	Properties of microorganisms include rapid growth, diverse use of food source and wide range of products. Examples of how some microorganisms work and are used in industrial processes, eg yeast in baking and brewing, bacteria for yoghurt, cheese and biofuel production.
6 The effect of limiting factors on photosynthesis.	♦ Carry out starch tests on plants in various conditions. ♦ Elodea/Cabomba investigations to find out about limiting factors. ♦ Investigate immobilised algae and hydrogen carbonate indicator to show the effect of light on the production of carbon dioxide. Use IT simulations and data logging.	If any of the requirements (light, water, carbon dioxide or a suitable temperature) are low or missing, the photosynthesis rate is limited. By overcoming these limitations, faster growth rates can be achieved.

Cell Biology		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
7 The process of respiration and the factors that can affect it.	♦ Carry out germinating peas experiments. ♦ Investigate the effect of mass of sugar/temperature on the rate of respiration in yeast. Use IT simulations and data logging.	Respiration is used to release energy for use in cells. Oxygen may or may not be used in yeast, plant and animal cells. When oxygen is available, yeast, plant and animal cells use glucose to produce carbon dioxide and water. Without oxygen, yeast and plant cells use glucose to produce alcohol and carbon dioxide. Without oxygen, animal cells use glucose to produce lactic acid. More energy is released per molecule of glucose when oxygen is present. The process is enzyme controlled in all cases and so is affected by temperature.
8 Controversial biological procedures.	♦ Investigate/debate any relevant interesting topic, eg gene therapy, pharming, transgenic animals and plants.	

Multicellular Organisms		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
1 Sexual and asexual reproduction and their importance for survival of species.	♦ Investigate reproduction in various organisms. ♦ Compare different methods, success rates and how these relate to species survival. ♦ Brine shrimp practicals. ♦ Investigate asexual reproduction in plants and animals using models, reference materials and videos.	Sexual reproduction involves two parents. All of the offspring produced are different from each other. Asexual reproduction involves only one parent and all the offspring produced are identical to that parent. Sexual reproduction is important for introducing variation in a population and enables species to adapt to changing environmental conditions. Asexual reproduction does not produce variation but it allows populations to grow quickly.
2 Propagating and growing plants.	♦ Carry out various propagation techniques with suitable plants.	Different methods to propagate plants, eg seeds, cuttings, bulbs, tubers and runners.
3 Commercial use of plants.	♦ Investigate increased yields of crops/fuel/medicines via pharming.	Plants are grown to provide food, fuel, raw materials and medicines. They are also used for aesthetic reasons. Pharming as a means of genetically modifying plants to produce medicinal products.
4 Genetic information.	♦ Investigate how genetics determines our features, ensures variation. ♦ Use *Reebops* or similar activities to model inheritance from two parents. Examine photographs of families to consider which features a child inherited from which parent.	Our genes determine our features. As we inherit half of our DNA from our father and the other half from our mother this ensures variation. Basic monohybrid crosses showing how dominant characteristics are passed on from parents to the F1 generation.

Multicellular Organisms		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
5 Growth and development of different organisms.	♦ Select a range of different organisms and compare their growth and development. ♦ Seed germination experiments to compare necessary/optimum conditions for growth. ♦ Investigate how chemicals or radiation can affect growth and development. ♦ Investigate commercial plant growing/visit a commercial plant nursery. ♦ Research/investigate the importance of suitable conditions eg diet and temperature to maintain growth and development. Debate the links between diet and growth and development disorders.	The growth and development of different organisms can be influenced by different factors. Water, oxygen and warmth are important for the growth and development of plants. Humans need a balanced diet, water, minerals, vitamins and suitable conditions.
6 Biological actions in response to internal and external changes to maintain stable body conditions.	♦ Investigate the effect of changing external temperature on core body temperature. Research causes of diabetes.	The basic principles of homeostasis through maintaining body temperature and regulating blood glucose. When body temperature decreases blood is diverted away from the skin, skin hairs become upright and shivering may occur. These actions bring the body temperature back to normal. When body temperature increases, blood is diverted to the skin and sweat is produced bringing the body temperature back to normal. If blood glucose levels are too high insulin (a hormone) is released. This tells the body to store the excess glucose in the liver. This brings the blood glucose levels back to normal. If blood levels are too low this excess glucose can be released again bringing them back to normal.

Life on Earth		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
1 Animal and plants species depend on each other.	♦ Investigate a variety of ecosystems/biomes, eg rainforest, tundra, desert, arctic, temperate, local ecosystems. ♦ Investigate various biotic factors, eg food availability, predators, disease and competition. Use sampling techniques, eg transect and quadrat analysis. ♦ Investigate/research how the addition/removal of a species will impact upon other species in an ecosystem.	Animals and plants depend upon each other for a number of things including food, shelter and pollination. The addition/removal of a species will impact upon other species within an ecosystem.
2 Impact of population growth and natural hazards on biodiversity.	♦ Investigate examples of human population growth and how these affect biodiversity. Investigate/research ecological footprints that measure human demands on earth's resources. ♦ Debate issues around conservation of endangered species to maintain biodiversity nationally and globally.	Human population growth has resulted in habitat destruction, deforestation, over-fishing, intensive agriculture, genetic pollution, climate change, acid rain, oil and chemical spills, sewage and litter. These environmental disruptions have had a negative impact on biodiversity. Natural hazards such as forest fires, earthquakes, tsunamis, floods and volcanic activity will also reduce biodiversity.
3 Nitrogen cycle.	♦ Investigate/research the nitrogen cycle including the role of microorganisms. ♦ Use card sorting to identify stages and processes of the cycle. ♦ Use compost columns/heaps/bins to investigate decay. ♦ Carry out water culture experiments with, eg lemna ♦ Investigate seedling development with/without nitrogen using sand or perlite.	Nitrogen is essential for organisms to make proteins. It is recycled through a set of processes known as the nitrogen cycle. Bacteria and fungi are vital to the nitrogen cycle. The basic nitrogen cycle showing the stages and processes involved.

Life on Earth		
Key areas	**Suggested learning activities**	**Exemplification of key areas**
4 Fertiliser design and environmental impact of fertilisers.	♦ Explore the use of natural and artificial fertilisers and the advantages/disadvantages of each, eg cost, specificity, purity, NPK composition. ♦ Visit a farm. ♦ Investigate the effects of fertilisers, eg algal blooms. ♦ Investigate Blue Flag beaches nationally and internationally.	When crops are harvested, nitrogen is taken out of the cycle so needs to be replaced. Nitrogen can be added to the soil in the form of nitrate fertilisers, manure or compost. Nitrogen in fresh water increases algal growth, blocking out the light. This causes death of organisms, decrease of oxygen and means less life can be supported.
5 Adaptations for survival.	♦ Research examples of structural and physiological adaptations which lead to species survival eg cactus, camel, polar bear, fish.	Adaptations can be structural, physiological or behavioural and help organisms survive and reproduce in their environment.
6 Learned behaviour in response to stimuli linked to species survival.	♦ Research examples of innate and learned behavioural adaptations which lead to species survival such as swarming, huddling, imprinting, migration, communication, eg waggle dance in bees. ♦ Practical investigation using, eg choice chambers, mazes, mirror drawing, touch typing. ♦ Practical investigation on habituation, eg in snails. ♦ Research group/cultural/social/territorial behaviour, eg robins, Japanese macaques. Use data to produce a graph/chart of daily activities. ♦ Research how insects (eg bees) learn to associate flower scent and colour with nectar.	Changes in learned behaviour due to internal and external stimuli are of benefit to the survival of species.