Name ……………………………………….…. Group ………………………….

**WHAT YOU NEED TO KNOW**

**AQA GCSE BIOLOGY. UNIT 7 – ECOLOGY**

The Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. All species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic. These ecosystems provide essential services that support human life and continued development. In order to continue to benefit from these services humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being.

**4.7.1 Adaptation, interdependence and competition**

| **Specification code** | **Expected knowledge and understanding** | **** |
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| 4.7.1.1 Communities | 1. Students should be able to describe:  * different levels of organisation in an ecosystem from individual organisms to the whole ecosystem * the importance of interdependence and competition in a community.  1. Students should be able to, when provided with appropriate information:    * suggest the factors for which organisms are competing in a given habitat    * suggest how organisms are adapted to the conditions in which they live. 2. An ecosystem is the interaction of a community of living organisms (biotic) with the non-living (abiotic) parts of their environment. 3. To survive and reproduce, organisms require a supply of materials from their surroundings and from the other living organisms there. 4. Plants in a community or habitat often compete with each other for light and space, and for water and mineral ions from the soil. Animals often compete with each other for food, mates and territory. 5. Within a community each species depends on other species for food, shelter, pollination, seed dispersal etc. If one species is removed it can affect the whole community. This is called interdependence. A stable community is one where all the species and environmental factors are in balance so that population sizes remain fairly constant. 6. Students should be able to extract and interpret information from charts, graphs and tables relating to the interaction of organisms within a community |  |
| 4.7.1.2  Abiotic factors | 1. Students should be able to explain how a change in an abiotic factor would affect a given community given appropriate data or context. 2. Abiotic (non-living) factors which can affect a community are:    * light intensity    * temperature    * moisture levels    * soil pH and mineral content    * wind intensity and direction    * carbon dioxide levels for plants    * oxygen levels for aquatic animals. 3. Students should be able to extract and interpret information from charts, graphs and tables relating to the effect of abiotic factors on organisms within a community. |  |
| 4.7.1.3  Biotic factors | 1. Students should be able to explain how a change in a biotic factor might affect a given community given appropriate data or context. 2. Biotic (living) factors which can affect a community are:    * availability of food    * new predators arriving    * new pathogens    * one species outcompeting another so the numbers are no longer sufficient to breed. 3. Students should be able to extract and interpret information from charts, graphs and tables relating to the effect of biotic factors on organisms within a community. |  |
| 4.7.1.4 Adaptations | 1. Students should be able to explain how organisms are adapted to live in their natural environment, given appropriate information. 2. Organisms have features (adaptations) that enable them to survive in the conditions in which they normally live. These adaptations may be structural, behavioural or functional. 3. Some organisms live in environments that are very extreme, such as at high temperature, pressure, or salt concentration. These organisms are called extremophiles. Bacteria living in deep sea vents are extremophiles. |  |

**4.7.2 Organisation of an ecosystem**

| **Specification code** | **Expected knowledge and understanding** | **** |
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| 4.7.2.1  Levels of organisation | 1. Students should understand that photosynthetic organisms are the producers of biomass for life on Earth. 2. Feeding relationships within a community can be represented by food chains. All food chains begin with a producer which synthesises molecules. This is usually a green plant or alga which makes glucose by photosynthesis. 3. A range of experimental methods using transects and quadrats are used by ecologists to determine the distribution and abundance of species in an ecosystem. 4. In relation to abundance of organisms students should be able to:    * understand the terms mean, mode and median    * calculate arithmetic means    * plot and draw appropriate graphs selecting appropriate scales for the axes. 5. Producers are eaten by primary consumers, which in turn may be eaten by secondary consumers and then tertiary consumers. 6. Consumers that kill and eat other animals are predators, and those eaten are prey. In a stable community the numbers of predators and prey rise and fall in cycles. Students should be able to interpret graphs used to model these cycles. |  |
| 4.7.2.2 How materials are cycled | 1. Students should:    * recall that many different materials cycle through the abiotic and biotic components of an ecosystem    * explain the importance of the carbon and water cycles to living organisms. 2. All materials in the living world are recycled to provide the building blocks for future organisms. 3. The carbon cycle returns carbon from organisms to the atmosphere as carbon dioxide to be used by plants in photosynthesis. 4. The water cycle provides fresh water for plants and animals on land before draining into the seas. Water is continuously evaporated and precipitated. 5. Interpret and explain the processes in diagrams of the carbon cycle, the water cycle. |  |
| 4.7.2.3 Decomposition (Biology only) | 1. Students should be able to explain how temperature, water and availability of oxygen affect the rate of decay of biological material. 2. Students should be able to:    * calculate rate changes in the decay of biological material    * translate information between numerical and graphical form    * plot and draw appropriate graphs selecting appropriate scales for the axes. 3. Gardeners and farmers try to provide optimum conditions for rapid decay of waste biological material. The compost produced is used as a natural fertiliser for growing garden plants or crops. 4. Anaerobic decay produces methane gas. Biogas generators can be used to produce methane gas as a fuel. |  |
| 4.7.2.4  Impact of environmental change (biology only) (HT only) | 1. Students should be able to evaluate the impact of environmental changes on the distribution of species in an ecosystem given appropriate information. 2. Environmental changes affect the distribution of species in an ecosystem. These changes include:    * temperature    * availability of water    * composition of atmospheric gases. 3. The changes may be seasonal, geographic or caused by human interaction. |  |

**Required practical activity 9:** measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species.

**Required practical activity 10:** investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.

**4.7.3 Biodiversity and the effect of human interaction on ecosystems**

| **Specification code** | **Expected knowledge and understanding** | **** |
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| 4.7.3.1 Biodiversity | 1. Biodiversity is the variety of all the different species of organisms on earth, or within an ecosystem. 2. A great biodiversity ensures the stability of ecosystems by reducing the dependence of one species on another for food, shelter and the maintenance of the physical environment. 3. The future of the human species on Earth relies on us maintaining a good level of biodiversity. Many human activities are reducing biodiversity and only recently have measures been taken to try to stop this reduction. 4. Explain how waste, deforestation and global warming have an impact on biodiversity. |  |
| 4.7.3.2  waste management | 1. Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. Unless waste and chemical materials are properly handled, more pollution will be caused. 2. Pollution can occur:    * in water, from sewage, fertiliser or toxic chemicals    * in air, from smoke and acidic gases    * on land, from landfill and from toxic chemicals. 3. Pollution kills plants and animals which can reduce biodiversity. |  |
| 4.7.3.3  Land use | 1. Humans reduce the amount of land available for other animals and plants by building, quarrying, farming and dumping waste. 2. The destruction of peat bogs, and other areas of peat to produce garden compost, reduces the area of this habitat and thus the variety of different plant, animal and microorganism species that live there (biodiversity). 3. The decay or burning of the peat releases carbon dioxide into the atmosphere. 4. Understand the conflict between the need for cheap available compost to increase food production and the need to conserve peat bogs and peatlands as habitats for biodiversity and to reduce carbon dioxide emissions |  |
| 4.7.3.4 Deforestation | 1. Large-scale deforestation in tropical areas has occurred to:    * provide land for cattle and rice fields    * grow crops for biofuels 2. Evaluate the environmental implications of deforestation. |  |
| 4.7.3.5  Global warming | 1. Students should be able to describe some of the biological consequences of global warming. 2. Levels of carbon dioxide and methane in the atmosphere are increasing, and contribute to ‘global warming’. 3. Understand that the scientific consensus about global warming and climate change is based on systematic reviews of thousands of peer reviewed publications. Explain why evidence is uncertain or incomplete in a complex context |  |
| 4.7.3.6 Maintaining biodiversity | 1. Students should be able to describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity. 2. Scientists and concerned citizens have put in place programmes to reduce the negative effects of humans on ecosystems and biodiversity. 3. These include:    * breeding programmes for endangered species    * protection and regeneration of rare habitats    * reintroduction of field margins and hedgerows in agricultural areas where farmers grow only one type of crop    * reduction of deforestation and carbon dioxide emissions by some governments    * recycling resources rather than dumping waste in landfill. 4. Evaluate given information about methods that can be used to tackle problems caused by human impacts on the environment. Explain and evaluate the conflicting pressures on maintaining biodiversity given appropriate information. |  |

**4.7.4 Trophic levels in an ecosystem (biology only)**

| **Specification code** | **Expected knowledge and understanding** | **** |
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| 4.7.4.1  Trophic levels | 1. Students should be able to describe the differences between the trophic levels of organisms within an ecosystem. 2. Trophic levels can be represented by numbers, starting at level 1 with plants and algae. Further trophic levels are numbered subsequently according to how far the organism is along the food chain.  * Level 1: Plants and algae make their own food and are called producers. * Level 2: Herbivores eat plants/algae and are called primary consumers. * Level 3: Carnivores that eat herbivores are called secondary consumers. * Level 4: Carnivores that eat other carnivores are called tertiary consumers. Apex predators are carnivores with no predators.  1. Decomposers break down dead plant and animal matter by secreting enzymes into the environment. Small soluble food molecules then diffuse into the microorganism. |  |
| 4.7.4.2 Pyramid of biomass | 1. Pyramids of biomass can be constructed to represent the relative amount of biomass in each level of a food chain. Trophic level 1 is at the bottom of the pyramid.      1. Students should be able to construct accurate pyramids of biomass from appropriate data. |  |
| 4.7.4.3 Transfer of biomass | 1. Students should be able to:  * describe pyramids of biomass * explain how biomass is lost between the different trophic levels.  1. Producers are mostly plants and algae which transfer about 1% of the incident energy from light for photosynthesis. 2. Only approximately 10% of the biomass from each trophic level is transferred to the level above it. 3. Losses of biomass are due to:  * not all the ingested material is absorbed, some is egested as faeces * some absorbed material is lost as waste, such as carbon dioxide and water in respiration and water and urea in urine.  1. Large amounts of glucose are used in respiration. 2. Students should be able to calculate the efficiency of biomass transfers between trophic levels by percentages or fractions of mass. 3. Students should be able to explain how this affects the number of organisms at each trophic level. |  |

**4.7.5 Food production (biology only)**

| **Specification code** | **Expected knowledge and understanding** | **** |
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| 4.7.5.1  Factors affecting food security | 1. Students should be able to describe some of the biological factors affecting levels of food security. 2. Food security is having enough food to feed a population. Biological factors which are threatening food security include:  * the increasing birth rate has threatened food security in some countries * changing diets in developed countries means scarce food resources are transported around the world * new pests and pathogens that affect farming * environmental changes that affect food production, such as widespread famine occurring in some countries if rains fail * the cost of agricultural inputs * conflicts that have arisen in some parts of the world which affect the availability of water or food.  1. Sustainable methods must be found to feed all people on Earth. Interpret population and food production statistics to evaluate food security. |  |
| 4.7.5.2 Farming techniques | 1. The efficiency of food production can be improved by restricting energy transfer from food animals to the environment. This can be done by limiting their movement and by controlling the temperature of their surroundings. 2. Some animals are fed high protein foods to increase growth. 3. Understand that some people have ethical objections to some modern intensive farming methods. Evaluate the advantages and disadvantages of modern farming techniques. |  |
| 4.7.5.3 Sustainable fisheries | 1. Fish stocks in the oceans are declining. It is important to maintain fish stocks at a level where breeding continues or certain species may disappear altogether in some areas. 2. Control of net size and the introduction of fishing quotas play important roles in conservation of fish stocks at a sustainable level. 3. Understand how application of different fishing techniques promotes recovery of fish stocks. |  |
| 4.7.5.4  Role of biotechnology | 1. Students should be able to describe and explain some possible biotechnical and agricultural solutions, including genetic modification, to the demands of the growing human population. 2. Modern biotechnology techniques enable large quantities of microorganisms to be cultured for food. 3. The fungus Fusarium is useful for producing mycoprotein, a protein- rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified. 4. A genetically modified bacterium produces human insulin. When harvested and purified this is used to treat people with diabetes. |  |