

Grade 4 skills checklist

109 skills that set grade 4 apart. Do the lists for the grades below first. Tick each one when you can do it.

Cell biology

- ☐ **Describe the structure of a bacterial cell** Cytoplasm and a cell membrane inside a cell wall, a single loop of DNA not in a nucleus, and often plasmids. (Eukaryotes and prokaryotes)
- ☐ **State the function of each structure** e.g. mitochondria are where aerobic respiration happens; ribosomes are where proteins are made. (Animal and plant cells)
- ☐ **State the function of each specialised cell** e.g. a nerve cell carries electrical impulses; phloem carries dissolved sugars. (Cell specialisation)
- ☐ **Say when animal and plant cells differentiate** Most animal cells differentiate at an early stage; many plant cells can differentiate throughout life. (Cell differentiation)
- ☐ **Calculate the total magnification of a microscope** Multiply the eyepiece lens magnification by the objective lens magnification, e.g. $\times 10$ and $\times 40$ give $\times 400$. (Microscopy)
- ☐ **Compare light and electron microscopes** Electron microscopes have much higher magnification and resolution; light microscopes can show living cells in colour. (Microscopy)
- ☐ **Name two ways of growing bacteria** In a nutrient broth solution, or as colonies on an agar gel plate. (Culturing microorganisms)
- ☐ **Describe what chromosomes are made of** Chromosomes are made of DNA, and each chromosome carries a large number of genes. (Chromosomes)
- ☐ **State the chromosome number in human cells** Body cells have 23 pairs (46 in total); sperm and egg cells have 23 single chromosomes. (Chromosomes)
- ☐ **Name the three stages of the cell cycle** Growth and DNA replication; mitosis; division of the cytoplasm and cell membrane. (Mitosis and the cell cycle)
- ☐ **Name where stem cells are found** In embryos, in adult bone marrow, and in the meristems of plants. (Stem cells)
- ☐ **Give examples of diffusion in living things** Oxygen and carbon dioxide in gas exchange; urea from cells into the blood plasma. (Diffusion)
- ☐ **Predict the direction of water movement** Water moves from the more dilute solution into the more concentrated solution. (Osmosis)
- ☐ **State where the energy comes from** Active transport needs energy from respiration. (Active transport)

Organisation

- ☐ **Define tissue, organ and organ system** A tissue is a group of cells with a similar structure and function, an organ is a group of tissues working together, and an organ system is a group of organs working together. (Principles of organisation)
- ☐ **State what each digestive enzyme produces** Amylase turns starch into sugars, proteases turn proteins into amino acids, and lipases turn lipids into fatty acids and glycerol. (The human digestive system)

- ☐ **Describe the food tests and positive results** Benedict's turns from blue to brick red when heated with sugar, iodine from orange-brown to blue-black with starch, and Biuret from blue to purple with protein. (The human digestive system)

- ☐ **Label the heart's chambers and main vessels** Right and left atria and ventricles, the vena cava, pulmonary artery, pulmonary vein, aorta and coronary arteries. (The heart and blood vessels)

- ☐ **State the function of each component** Plasma transports dissolved substances, red blood cells carry oxygen, white blood cells defend against pathogens and platelets help the blood clot. (Blood)

- ☐ **Describe what happens in coronary heart disease** Layers of fatty material build up inside the coronary arteries and narrow them. (Coronary heart disease)

- ☐ **Tell communicable and non-communicable diseases apart** Communicable diseases are caused by pathogens and can spread; non-communicable diseases cannot be passed from one person to another. (Health issues)

- ☐ **Match risk factors to the diseases they affect** Diet, smoking and lack of exercise → cardiovascular disease; obesity → type 2 diabetes; alcohol → liver and brain; smoking → lung disease and lung cancer; carcinogens → cancer. (Lifestyle and non-communicable diseases)

- ☐ **Describe a benign tumour** A growth of abnormal cells contained in one area, usually within a membrane, that does not invade other parts of the body. (Cancer)

- ☐ **Label a leaf cross-section** From top to bottom: waxy cuticle, upper epidermis, palisade mesophyll, spongy mesophyll with air spaces and veins, lower epidermis with stomata. (Plant tissues)

- ☐ **State where meristem tissue is found** At the growing tips of shoots and roots, where cells divide to make new cells. (Plant tissues)

- ☐ **Define transpiration and translocation** Transpiration is the loss of water vapour from the leaves; translocation is the movement of dissolved sugars through the phloem. (Plant organ system)

Infection and response

- ☐ **Describe how pathogens are spread** By direct contact, by water and by air, and also in food, in body fluids and by vectors. (Communicable (infectious) diseases)

- ☐ **Describe the symptoms and spread of measles** Fever and a red skin rash; it is spread by breathing in droplets from coughs and sneezes. (Viral diseases)

- ☐ **Describe how HIV is spread** By sexual contact or by exchange of body fluids such as blood, e.g. when drug users share needles. (Viral diseases)

- ☐ **Give the symptoms of *Salmonella* food poisoning** Fever, abdominal cramps, vomiting and diarrhoea, caused by the bacteria and the toxins they secrete. (Bacterial diseases)

- ☐ **Give the symptoms of gonorrhoea** A thick yellow or green discharge from the vagina or penis, and pain on urinating. (Bacterial diseases)

- ☐ **Describe the symptoms of rose black spot** Purple or black spots develop on the leaves, which often turn yellow and drop early. (Fungal diseases)

- ☐ **State how rose black spot is spread** It is spread in the environment by water (e.g. splashing rain) or by wind. (Fungal diseases)

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- ☐ **Describe the main symptom of malaria** Recurrent episodes of fever (the fever keeps coming back); malaria can be fatal. (Protist diseases)
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- ☐ **Identify the vector of malaria** Mosquitoes carry the protist and pass it to people when they bite them. (Protist diseases)
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- ☐ **Describe how each defence stops pathogens** Skin is a barrier; mucus traps pathogens; cilia move the mucus away; stomach acid kills pathogens. (Human defence systems)
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- ☐ **Name three ways white blood cells defend** Phagocytosis, producing antibodies and producing antitoxins. (Human defence systems)
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- ☐ **Describe what a vaccine makes the body do** It stimulates white blood cells to produce antibodies against the pathogen. (Vaccination)
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- ☐ **Explain why antibiotics don't treat viral diseases** Antibiotics kill bacteria but cannot kill viruses. (Antibiotics and painkillers)
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- ☐ **State what new drugs are tested for** Toxicity (is it harmful?), efficacy (does it work?) and dose (how much should be given?). (Discovery and development of drugs)
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- ☐ **Name chemical defences of plants** Antibacterial chemicals, and poisons that deter herbivores. (Plant defence responses)
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- ☐ **Name mechanical adaptations of plants** Thorns and hairs, leaves that droop or curl when touched, and mimicry. (Plant defence responses)
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Bioenergetics

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- ☐ **Recognise the formulae of the four substances** Carbon dioxide is CO_2 , water is H_2O , glucose is $\text{C}_6\text{H}_{12}\text{O}_6$ and oxygen is O_2 . (Photosynthetic reaction)
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- ☐ **Explain what a limiting factor is** The factor in shortest supply, which stops the rate of photosynthesis increasing; raising it raises the rate. (Rate of photosynthesis)
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- ☐ **Describe the light intensity required practical** Put pondweed at different distances from a lamp and count the oxygen bubbles, or measure the volume of oxygen, in a set time. (Rate of photosynthesis)
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- ☐ **State what cellulose is used for** Cellulose strengthens the cell wall of plant cells. (Uses of glucose from photosynthesis)
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- ☐ **Name where plants store starch and oils** Starch is stored in leaves, roots and tubers such as potatoes; many seeds store oils. (Uses of glucose from photosynthesis)
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- ☐ **Write the anaerobic equations for muscles and yeast** In muscles: glucose $\rightarrow$ lactic acid. In plant cells and yeast: glucose $\rightarrow$ ethanol + carbon dioxide. (Aerobic and anaerobic respiration)
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- ☐ **Explain why heart and breathing rates increase** To supply the muscles with more oxygenated blood for the extra respiration needed to contract. (Response to exercise)
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- ☐ **Give examples of metabolic reactions** For example respiration, making starch, glycogen or cellulose from glucose, making lipids and proteins, and making urea. (Metabolism)
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Homeostasis and response

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- ☐ **Name the three parts of a control system** Receptors, coordination centres and effectors. (Homeostasis)
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- ☐ **Name the parts of the CNS** The central nervous system (CNS) is the brain and spinal cord. (Structure and function)
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- ☐ **Put the reflex arc in order** Stimulus → receptor → sensory neurone → relay neurone → motor neurone → effector → response. (Structure and function)
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- ☐ **State the function of each region** Cerebral cortex: consciousness, intelligence, memory, language. Cerebellum: coordinates muscles. Medulla: unconscious activities. (The brain)
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- ☐ **State the function of each part** E.g. the retina contains light receptors; the optic nerve carries impulses to the brain. (The eye)
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- ☐ **Name where temperature is monitored** The thermoregulatory centre in the brain, which has receptors sensitive to blood temperature. (Control of body temperature)
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- ☐ **List the responses to overheating** Vasodilation and more sweat produced by sweat glands. (Control of body temperature)
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- ☐ **Locate the main endocrine glands** Pituitary, thyroid, adrenal glands, pancreas, ovaries and testes on a body diagram. (Human endocrine system)
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- ☐ **Match glands to their hormones** E.g. pancreas: insulin; testes: testosterone. (Human endocrine system)
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- ☐ **Describe how insulin lowers blood glucose** Insulin makes glucose move from the blood into cells; liver and muscle cells store it as glycogen. (Control of blood glucose concentration)
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- ☐ **Describe how the kidneys produce urine** Filtration of the blood, then selective reabsorption of useful substances such as glucose, some ions and water. (Maintaining water and nitrogen balance)
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- ☐ **Define ovulation** The release of a mature egg from an ovary, about every 28 days. (Hormones in human reproduction)
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- ☐ **Explain how barrier methods work** Condoms and diaphragms stop sperm reaching the egg. (Contraception)
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- ☐ **Describe how shoots and roots respond** Shoots grow towards light and against gravity; roots grow downwards, in the direction of gravity. (Control and coordination)
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Inheritance, variation and evolution

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- ☐ **Define sexual reproduction** The joining (fusion) of a male gamete and a female gamete. (Sexual and asexual reproduction)
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- ☐ **State how many gametes meiosis produces** The cell divides twice to form four gametes. (Meiosis)
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- ☐ **Give an advantage of asexual reproduction** Only one parent is needed, so there is no need to find a mate. (Pros and cons of sexual and asexual reproduction)
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- ☐ **Give an advantage of sexual reproduction** It produces variation in the offspring. (Pros and cons of sexual and asexual reproduction)
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- ☐ **Describe the structure of DNA simply** DNA is a polymer made up of two strands forming a double helix. (DNA and the genome)
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- ☐ **Put nucleus, chromosome and gene in size order** Nucleus (largest), then chromosome, then gene (a small section of DNA on a chromosome). (DNA and the genome)
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- ☐ **Name the four bases in DNA** The four bases are A, C, G and T. (DNA structure)
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- ☐ **Use genotype, phenotype, homozygous and heterozygous correctly** Genotype is the alleles present, phenotype is the characteristic; homozygous means the same alleles, heterozygous different. (Genetic inheritance)
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- ☐ **State which allele causes each disorder** Polydactyly is caused by a dominant allele; cystic fibrosis by a recessive allele. (Inherited disorders)
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- ☐ **Give the sex chromosomes of each sex** Females are XX; males are XY. (Sex determination)
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- ☐ **Classify causes of variation** Genetic (genes inherited), environmental (conditions of development) or a combination of both. (Variation)
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- ☐ **State when simple life first developed** All species evolved from simple life forms that first developed more than three billion years ago. (Evolution)
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- ☐ **Give examples of chosen characteristics** Disease resistance in crops, more meat or milk, gentle dogs, large or unusual flowers. (Selective breeding)
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- ☐ **Define genetic engineering** Modifying an organism's genome by introducing a gene from another organism to give a desired characteristic. (Genetic engineering)
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- ☐ **Give examples of genetic engineering** Bacteria that make human insulin; crops resistant to disease, insects or herbicides; bigger, better fruits. (Genetic engineering)
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- ☐ **Describe taking cuttings** Gardeners cut a piece from a parent plant and grow it into a new, identical plant. (Cloning)
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- ☐ **Describe how Darwin developed his theory** Observations on a round-the-world expedition, backed by experimentation and discussion with other scientists. (Theory of evolution)
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- ☐ **Recall what Wallace is best known for** His work on warning colouration in animals and his theory of speciation. (Speciation)
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- ☐ **State Mendel's key observation** The inheritance of each characteristic is determined by 'units' that are passed on to descendants unchanged. (The understanding of genetics)
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- ☐ **Name two types of evidence for evolution** The fossil record and the evolution of antibiotic resistance in bacteria. (Evidence for evolution)
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- ☐ **Describe three ways fossils form** Parts that have not decayed, parts replaced by minerals, and preserved traces such as footprints. (Fossils)
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- ☐ **List the causes of extinction** Environmental change, new predators, new diseases, new competitors and catastrophic events. (Extinction)
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- ☐ **State ways to reduce antibiotic resistance** Don't prescribe antibiotics for viral or non-serious infections, complete the course, and restrict their use in farming. (Resistant bacteria)
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- ☐ **Use binomial names** An organism's scientific name is its genus followed by its species, e.g. Homo sapiens. (Classification of living organisms)
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Ecology

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- ☐ **List what plants compete for** Light and space, and water and mineral ions from the soil. (Communities)
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- ☐ **List what animals compete for** Food, mates and territory. (Communities)
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- ☐ **List the abiotic factors in the specification** Light intensity, temperature, moisture level, soil pH and mineral content, wind intensity and direction, carbon dioxide (plants) and oxygen (aquatic animals). (Abiotic factors)
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- ☐ **List the four biotic factors in the specification** Availability of food, new predators arriving, new pathogens, and one species outcompeting another. (Biotic factors)
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- ☐ **Classify adaptations as structural, behavioural or functional** Structural means body features, behavioural means what it does, and functional means processes inside the body. (Adaptations)
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- ☐ **State why food chains start with producers** Producers (green plants and algae) make glucose by photosynthesis, so they produce the biomass for the rest of the chain. (Levels of organisation)
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- ☐ **Calculate a mean, median and mode** Mean = total ÷ number of values; median = middle value when in order; mode = most common value. (Levels of organisation)
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- ☐ **Name the processes in the water cycle** Evaporation, transpiration, condensation, precipitation, and water draining back into rivers and seas. (How materials are cycled)
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- ☐ **Name the three factors affecting decay rate** Temperature, water (moisture) and the availability of oxygen. (Decomposition)
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- ☐ **Name human activities that reduce biodiversity** For example pollution, building, farming, deforestation and destroying peat bogs. (Biodiversity)
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- ☐ **Explain why more waste is produced** The human population is growing rapidly and the standard of living is rising, so more resources are used. (Waste management)
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- ☐ **Explain how land use reduces biodiversity** Habitats are destroyed, so there is less space, food and shelter for other plants and animals. (Land use)
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- ☐ **Give reasons for tropical deforestation** To provide land for cattle and rice fields, and to grow crops for biofuels. (Deforestation)
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- ☐ **Give human activities that increase these gases** Burning fossil fuels, deforestation and destroying peat add carbon dioxide; cattle, rice fields and landfill add methane. (Global warming)
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- ☐ **Describe producers, herbivores and carnivores** Producers make their own food, herbivores eat plants or algae, and carnivores eat other animals. (Trophic levels)
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- ☐ **Identify the trophic levels on a pyramid** Trophic level 1 (the producers) is always the bottom bar. (Pyramids of biomass)
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- ☐ **State the typical transfer percentages** Producers transfer about 1% of the incident light energy for photosynthesis; about 10% of biomass passes to the next level. (Transfer of biomass)
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- ☐ **List factors that threaten food security** Rising birth rate, changing diets, new pests and pathogens, environmental change, the cost of agricultural inputs and conflicts. (Factors affecting food security)
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- ☐ **Name ways to make animal farming more efficient** Limit the animals' movement, control the temperature of their surroundings, and feed them high-protein food. (Farming techniques)
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- ☐ **Name two methods to conserve fish stocks** Controlling net (mesh) size and introducing fishing quotas. (Sustainable fisheries)
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☐ **Describe how mycoprotein is produced** *Fusarium* is grown on glucose syrup in aerobic conditions, then the biomass is harvested and purified. (Role of biotechnology)

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