Knowledge Organiser: Year 9 – Variation & Inheritance

Key Vocabulary

Term	Definition
DNA	The molecule that carries genetic information.
Gene	A section of DNA that codes for a specific protein.
Chromosome	A thread-like structure made of DNA found in the nucleus.
Genome	All the genetic material of an organism.
Allele	Different versions of the same gene.
Dominant	An allele that shows its effect even if only one copy is present.
Recessive	An allele that only shows if both copies are the same.
Mutation	A change in the DNA sequence of a gene.
Inheritance	The passing of genetic information from parents to offspring.
Pedigree analysis	A diagram showing the inheritance of traits in a family.
Selective breeding	Choosing parents with desired traits to produce offspring with those traits.
Monohybrid inheritance	The inheritance of a single gene.

Key Knowledge

- DNA contains genes that determine inherited characteristics.
- Chromosomes are found in pairs; humans have 23 pairs (46 total).
- Each gene has two alleles – one from each parent.
- Dominant alleles override recessive ones in determining traits.
- Pedigree diagrams show how traits are passed through generations.
- Mutations are changes in DNA that can be harmful, beneficial, or neutral.
- Sex is determined by X and Y chromosomes – XX for females, XY for males.

• Selective breeding is used in agriculture and farming to enhance traits.

• Monohybrid crosses show how one gene is inherited and how traits appear in offspring.

Lesson Sequence

- Genes and DNA

- Chromosomes and the genome

- Inheritance

- Pedigree analysis

- Mutations

- Sex determination

- Selective breeding

- Monohybrid inheritance

Possible Misconceptions

• All traits are inherited – some traits are influenced by the environment.

• Recessive traits are less important – they just require two copies to show.

• Only parents affect inheritance – all genetic information comes from both parents, not environment.

• Mutations are always harmful – some can be neutral or even beneficial.

• Selective breeding always improves animals – it can reduce genetic diversity and cause problems.

3 Key Questions for the Topic

1. How are characteristics passed from parents to offspring?

2. What roles do genes, chromosomes, and DNA play in inheritance?

3. How can pedigree diagrams and selective breeding be used to understand and influence traits?

Knowledge Organiser: Year 9 – Earth Chemistry

Key Vocabulary

Term	Definition
Atmosphere	The layer of gases surrounding Earth.
Greenhouse gases	Gases like carbon dioxide and methane that trap heat in the atmosphere.
Global warming	The increase in Earth's average surface temperature due to greenhouse gases.
Pollution	Harmful substances released into the environment.
Acid rain	Rain that contains acidic gases like sulfur dioxide and nitrogen oxides.
Eutrophication	Overgrowth of algae due to excess nutrients, leading to oxygen depletion in water.
Nitrogen cycle	The process by which nitrogen is cycled through the environment and living organisms.
Carbon cycle	The cycle through which carbon is exchanged among the biosphere, geosphere, and atmosphere.
Fossil fuels	Fuels such as coal, oil, and natural gas formed from ancient organisms.
Crude oil	A mixture of hydrocarbons found underground that is refined into fuels.
Hydrocarbons	Compounds made of hydrogen and carbon atoms.
Combustion	A chemical reaction where a substance reacts with oxygen and releases energy.
Displacement reaction	A reaction where a more reactive element replaces a less reactive one.
Electrolysis	Using electricity to split compounds and extract elements like metals.

Key Knowledge

- The atmosphere is mainly nitrogen and oxygen, with small amounts of other gases.
- Greenhouse gases trap heat and contribute to global warming.
- Pollution from burning fossil fuels causes acid rain, which harms plants and buildings.

• Eutrophication from fertilisers causes algae blooms and reduces oxygen in water.

• The nitrogen cycle involves bacteria converting nitrogen into usable forms for plants.

• The carbon cycle moves carbon through the atmosphere, living things, and rocks.

• Crude oil is separated into fractions using fractional distillation.

• Organic chemistry is the study of carbon compounds, especially hydrocarbons.

Lesson Sequence

- Earth's atmosphere

- Greenhouse gases and global warming

- Pollution and acid rain

- Eutrophication

- Nitrogen cycle

- Carbon cycle

- Fossil fuels

- Crude oil and fractions

- Intro to organic chemistry

- Combustion of hydrocarbons

- Extraction of metals (displacement)

- Extraction of metals (Electrolysis)

Possible Misconceptions

• Greenhouse gases are all harmful – some are natural and essential in moderation.

• All pollution is visible – many pollutants like CO_2 are invisible but harmful.

• The nitrogen and carbon cycles are fast – they can take years or centuries to complete.

3 Key Questions for the Topic

1. How do human activities impact Earth’s atmosphere and ecosystems?

2. What roles do the nitrogen and carbon cycles play in sustaining life?

3. How are different substances like fuels and metals obtained from the Earth?

Knowledge Organiser: Year 9 – Radiation

Key Vocabulary

Term	Definition
Radiation	Energy emitted as waves or particles from a source.
Isotope	Atoms of the same element with different numbers of neutrons.
Alpha particle	A type of radiation made of 2 protons and 2 neutrons.
Beta particle	A high-energy electron emitted from a nucleus.
Gamma ray	High-energy electromagnetic radiation with no mass or charge.
Half-life	Time taken for half the radioactive nuclei in a sample to decay.
Decay	The process by which an unstable nucleus loses energy.
Nuclear equation	A representation of a radioactive decay process using symbols.
Geiger counter	A device used to detect radiation.
Ionising radiation	Radiation that can remove electrons from atoms, potentially causing damage.

Key Knowledge

• Radiation is energy emitted from unstable atomic nuclei.

• Atoms with the same number of protons but different neutrons are isotopes.

• There are three main types of radiation: alpha, beta, and gamma.

• Alpha is the most ionising but least penetrating; gamma is the least ionising but most penetrating.

• Radiation can be detected using a Geiger counter or photographic film.

• Radioactive decay can be represented with nuclear equations.

• Half-life is the time taken for half of a radioactive sample to decay.

• Radiation has uses in medicine, industry, and power generation, but it can also damage cells and DNA.

Lesson Sequence

- Atomic structure and isotopes

- Radioactive decay

- Background radiation

- Half life

- Nuclear equations and decay

- Uses and dangers of radiation

- The Electromagnetic spectrum

Possible Misconceptions

• All radiation is harmful – some radiation is naturally present and safe in small amounts.

• Radiation makes objects radioactive – only direct exposure to radioactive materials can cause contamination.

• Gamma radiation is a particle – it is actually electromagnetic radiation.

• All radioactive materials decay at the same rate – different isotopes have different half-lives.

• Radiation is instantly deadly – harm depends on type, dose, and exposure time.

3 Key Questions for the Topic

1. What are the different types of radiation and how do they differ?

2. How does radioactive decay work and how can we detect it?

3. What are the benefits and risks of using radiation in society?

Knowledge Organiser: Year 9 – Ecology

Key Vocabulary

Term	Definition
Ecology	The study of how organisms interact with each other and their environment.
Ecosystem	A community of organisms and their physical environment.
Biodiversity	The variety of living organisms in an area.
Abiotic factor	A non-living part of the environment that affects living organisms.
Biotic factor	A living part of the environment that affects other organisms.
Producer	An organism that makes its own food using sunlight (e.g., plants).
Consumer	An organism that eats other organisms to gain energy.
Predator	An animal that hunts and eats other animals.
Prey	An animal that is hunted and eaten by predators.
Food chain	A sequence showing the transfer of energy between organisms.
Energy transfer	The movement of energy through a food chain.
Decomposer	An organism that breaks down dead matter and recycles nutrients.

Key Knowledge

• Ecology explores relationships between living organisms and their environments.

• Biodiversity is important for the stability of ecosystems.

• Abiotic factors include temperature, light, and water; biotic factors include competition and predation.

• Producers convert sunlight into energy through photosynthesis.

• Consumers obtain energy by eating other organisms.

• Feeding relationships are shown in food chains and food webs.

• Only about 10% of energy is transferred from one trophic level to the next.

• Decomposers break down dead organisms and return nutrients to the soil.

Lesson Sequence

- Habitats

- Biodiversity

- Ecosystem interactions

- Human impacts

- Population dynamics

- Conservation

Possible Misconceptions

• All organisms get energy directly from the Sun – only producers do.

• Energy is recycled – energy is lost as heat and not recycled.

• Decomposers are not important – they are vital for recycling nutrients.

• Food chains show all feeding relationships – food webs are more accurate for ecosystems.

• Biodiversity is not affected by humans – many human activities reduce biodiversity.

3 Key Questions for the Topic

1. What roles do organisms play in an ecosystem?

2. How is energy transferred between organisms in a food chain?

3. Why is biodiversity important for ecosystems?

Knowledge Organiser: Year 9 – Homeostasis

Key Vocabulary

Term	Definition
Homeostasis	The maintenance of a constant internal environment.
Stimulus	A change in the environment that is detected by the body.
Receptor	A structure that detects stimuli.
Effector	A muscle or gland that responds to a stimulus.
Nervous system	A system of nerves and neurons that sends rapid electrical messages.
Hormones	Chemical messengers carried in the blood.
Reflex	An automatic and rapid response to a stimulus.
Thermoregulation	The control of body temperature.
Insulin	A hormone that lowers blood glucose levels.
Glucagon	A hormone that raises blood glucose levels.

Key Knowledge

• Homeostasis keeps conditions in the body within safe limits.

• The nervous system sends fast electrical messages for immediate responses.

• Hormones are slower but longer-lasting chemical messengers.

• Reflex actions are automatic and protect the body from harm.

• Thermoregulation involves sweating and vasodilation when hot, and shivering and vasoconstriction when cold.

• Blood glucose is regulated by insulin (lowers) and glucagon (raises) from the pancreas.

• A coordinated response involves stimulus → receptor → coordination centre → effector → response.

Lesson Sequence

- Coordination: Nervous and hormonal responses

- Reflexes

- Reflex practical CORMMSS practice

- Thermoregulation

- Glucose control in the blood

- Homeostasis case studies

Possible Misconceptions

• All responses are voluntary – reflexes are involuntary and do not involve conscious thought.

• Hormones and nerves do the same job – they differ in speed, duration, and method of transmission.

• Homeostasis only controls temperature – it also controls blood sugar, water balance, and more.

• Glucose is only used for energy – it is also stored or converted when in excess.

• Sweating cools you directly – it cools as the sweat evaporates, not just when it forms.

3 Key Questions for the Topic

1. How do the nervous and hormonal systems work together to maintain homeostasis?

2. What happens in a reflex action and why is it important?

3. How does the body regulate internal temperature and blood glucose levels?