Science at Casterton

Purpose of Study

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

Aims

The national curriculum for science aims to ensure that all pupils: Develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics. Develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them. Are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Hours of Study (1 lesson = 1 hour)

Year (total in year group)	Hours per two week cycle	Hours per year (40 weeks)	Number of students
7 (210)	9	180	
8 (210)	9 split between the 3 science subjects equally	180	
9 (210)	12 split between the 3 science subjects equally	240	
10 (180)	12 split between the 3 science subjects equally	240	
11 (120)	12 split between the 3 science subjects equally	240	

Timetabling and Setting Notes

Science (KS3) is taught in mixed ability groups. Where timetabling and staffing allows, we would look to create a smaller supported group for the start of Yr 8 onwards but this isn't always possible. In Yr 7 each class has 9 lessons of science over 2 weeks and this is taught by the same teacher throughout the year. This helps with transition and reduces the number of teachers a pupil sees on their timetable each week. It also allows staff to gain a clear picture of each pupil and their academic profile.

In Yr's 8 to 9 pupils continue to be taught in mixed ability groups (with the creation of a smaller supported group if timetabling allows). Pupils are now taught by 3 different teachers, 1 for Biology, 1 for Chemistry and 1 for Physics. Over 2 weeks each pupil will have 3 Biology, 3 chemistry and 3 Physics lessons Towards the end of Yr 9 foundation Trilogy, higher trilogy and either 1 or 2 Separate Triple award science groups are set up. The Triple group(s) is aimed at pupils showing an aptitude and interest in science having performed consistently well over the course of Yr 9.

During Yr 10 and 11 pupils have 4 lessons of each science over the 2 week timetable and are, as far as possible, taught by teachers within their preferred specialism. There is no extra time to teach the additional triple award content as it has the same curriculum time as the Trilogy pathway.

Year 9 Options Notes

Pupils follow 1 of 3 GCSE pathways in science. They study either Trilogy Foundation, Trilogy Higher or Triple science at higher. Pupils are selected for each pathway based on academic performance in Yr 9. There is some flexibility to move between pathways, particularly earlier on in the course when very little triple award material has been taught. However, it would be unusual to move once Yr 11 has started unless a pupil was finding the demands of the triple science course or higher trilogy course too much.

Programmes of Study

Terms	Year 7	Year 8	Year 9
1	**Methods and skills in science**: Emphasis on measuring, recording, planning, fair testing, results analysis and evaluation, graph work, practical confidence. The remaining topics are then taught throughout the rest of Yr 7 but some groups may start with Physics, others biology etc.	Intervention based on performance in the Yr 8 baseline test. And see below for bio/chem/phys term 1-3 approx work.	Chemistry: Baseline: Chemistry Basics. Formula, equations, separation techniques, displacement, basic atomic structure. Biology: Animal, plant, bacterial cells, microscope work, mitosis, diffusion, osmosis and active transport. Physics: Electricity (part 1) series parallel, current charge, resistance

2	Biology part 1: Cells, Human Biology, Reproduction	Biology part 1: **Terms 1-3 approx** Respiration, effects of exercise, breathing and gas exchange, digestion, food tests, effects of smoking. Chemistry part 1: **Terms 1 to 3/4 approx.** Elements, compounds, mixtures, Basic P.Table intro and symbols, changes of state, separation techniques, chemical reactions (many examples), word equations, oxidation, properties metals/non-metals Physics part 1: **Terms 1 to 3 approx.** Big bang, solar system, balanced/unbalanced forces, resultant, speed distance, float/sink, states of matter conduction, convection, radiation, heating/cooling gases	Chemistry: Extraction of metals, oxidation/reduction, metal reactivity, displacement, alloys, alternative methods of metal extraction. Biology: contin term 1 and into Specialised cells, organs into systems and digestion and enzymes, food testing Physics: Electricity (part 2), AC, power and efficiency, lamps, diodes
3	Biology part 2: Food Chains, classification, adaptation, sampling in the environment	Biology part 2: **Terms 4 to 6 approx.** Inheritance and variation, disease and immunity. Selective breeding, Photosynthesis. Physics part 2: **Terms 4 to 6 approx.** Sound and ear, light and eye, electromagnetic spectrum basics, series parallel circuits, pd, resistance, static electricity, types of energy, sankey diagrams and efficiency	Chemistry: Crude oil, hydrocarbons, fractional distillation, intro to polymers, combustion and polluting effects of burning Biology: continue from term 2 and moving onto Breathing and gas exchange, the heart and circulation and related health issues and disease connected to respiratory system and circulation eg smoking and heart disease. Physics: Energy: types efficiency, dissipation, work done, conduction, radiation, insulating, alternative energy,

			fossil fuel issues and energy impact on environment.
4	Chemistry part 1: Acids and alkalis and Geology and Rocks		Chemistry: Complete term 3 areas, start: Composition of current atmosphere. Formation of early atmosphere, greenhouse effect, gas tests, making water potable, concentration of solutions. Biology: continue with term 3 topic areas Physics: Energy continued
5	Chemistry part 2: Matter and consolidation of acids and alkali concepts.	Chemistry part 2: **Terms 5/6 approx.** Displacement, diffusion, pressure, changes of state,	Chemistry: Water atmosphere continue Biology: pathogens and disease: transmission, prevention and cure. Immune system, vaccinations and antibiotics. Physics: atomic structure, isotopes, history of development of atomic model, alpha beta and gamma radiation and contamination, background radiation. Nuclear.
6	Physics part 1: Electricity intro, Energy Types and changes, renewables and alternatives like nuclear		Chemistry: Brief start on Rates of reaction topic. Physics: as term 5

	Physics part 2: Magnets and Forces		Biology: as term 5
7			

Terms	Year 10	Year 11
1	Chemistry: Rates of reaction, measuring and changing rate (required practical), collision theory, energy profile diagrams, rate from graphs, bonding ionic, covalent and metallic Physics: Finish atomic structure. Particles, change of states, density, internal heat, specific heat and latent heat, particle model and pressure. Triple extra: Fusion and fission. Pressure in gases and increasing pressure. Biology: Photosynthesis detail, aerobic/anaerobic respiration, effects of exercise on body. Triple extra: monoclonal antibodies and plant diseases	Chemistry: **Term 1 and 2** Completion of Quantitative topic. Reversible reactions and Life cycle assessments: Equilibrium, Le Chateliers Principle, product life cycle assessments For trilogy. Triple often do chemical testing next. Triple extra: Haber process, fertilizers and % yield (NOTE, some prefer to do this topic last) Physics: Waves to finish for trilogy/ start for triple (see term 6 Yr 10) Triple extra: reflection of waves, sound waves, detection and exploring using waves Biology: DNA continued, patterns of inheritance, Variation, natural selection, genetic engineering and selective breeding. Triple extra: protein synthesis, cloning in plants and animals

2	Chemistry: Structure and bonding. Linking structure and bonding to properties, intermolecular forces, giant covalent molecules, ionic substances, formulations/pure. Mock revision, Triple extra: thermosoftening and thermosetting polymers, nano and fullerene detail. Physics: particle model as term 1 with mock revision Triple extra: Biology: Homeostasis, sweating, body temp control, blood sugar, endocrine system and hormone control, menstruation cycle, fertility Triple extra:	Triple Chemistry: Qualitative tests. Flame tests, chemical testing, spectroscopy, Physics: Electromagnetism (possibly term 3 for triple): Electromagnetic spectrum, refraction (higher), radio waves, UV, use and applications such a s communication, cooking, medical. Magnets (permanent and induced), electromagnetism (left hand rule, induced potential, generator effect, loudspeakers, microphones, transformers all higher only) Triple extra: Lenses, real virtual images, colour filters and diffraction of visible light, black body emission and absorption Biology: Classification, evolution, ecosystems and by what and how communities are affected, feeding relationships, adaptations, sampling, biodiversity and effects of things like climate change and deforestation. Triple extra: theory of evolution by natural selection, speciation, Mendel and genetics development
3	Chemistry: Salt making: how to make salts (required practical) and salt making rules, acid alkali theory, pH number revision. Triple extra: intro to titration (no moles calculation) Physics: Forces: Split into 2 and taught to the end of Yr 10 for triple but trilogy will likely start Waves topic term 6: Scaler and vector quantities, gravity, resultant, elasticity, motion (speed, velocity, acceleration), newtons laws of motion, braking distances.	Chemistry: complete reversible, LCA trilogy, (triple may start this this term depending on teacher) Triple extra: Organic chemistry: Alkenes, Alcohols, Carboxylic acids, esters, amino acids and DNA, pH theory, strong/weak acids, **Term 3 into 4** complete organics and ensure rusting/corrosion, gold rating completed. Physics: Trilogy finish electromagnetism and essentially start revising.

	Triple extra: Momentum and changes in momentum, levers, gears, pressure in fluids. Biology: as term 2 Triple extra: Liver and kidney in Water and nitrogen balance in body, plant hormones, the brain and eye, eg focusing	Triple extra: Electromagnetism complete and Space Topic : Space: solar system, planet orbits, life cycle of stars, natural and artificial satellites, red shift. Biology: As term 2. Continue Triple extra: As term 2 and decomposition, trophic levels/biomass, food production,
4	Chemistry: Energy and Electrolysis: **Term 4 into 5** Exo/endo thermic reaction, energy profile diagrams, comparing fuels, bond energy calculations, electrolysis and associated theory (required practical) Triple extra: Simple cells, (rechargeable and non), Hydrogen Fuel cells. Physics: Forces continued Triple extra: Biology: as term 3 Triple extra:	Trilogy revision Triple Chemistry: Finish organics or revesible/LCA depending on order, then revision Triple Physics: Finish off Space possibly then revision. Triple Biology: Finish Ecology loose ends then revision.
5		Revision all subjects.
5/6		

	Chemistry: Quantitative Chemistry: Relative molecular masses, predicting quantities, conservation of mass, Moles, mole calculations, limiting reactant, estimating errors, revise concentration g/dm^3 . Triple extra: Titration to calculate unknown concentration (required practical) Physics: Forces continued for triple but trilogy will start waves. Waves: transverse, longitudinal, properties of waves, wave equation, sound waves (higher) Biology: Sexual and asexual reproduction, meiosis, DNA and genome Triple extra: Advantages/disadvantages of 2 types reproduction, Structure of DNA	[redacted]

Powerful Core Knowledge

How we identify powerful core subject knowledge

Running though all science disciplines is the underlying need to have an appreciation of the scientific method and how evidence gathered in a fair and valid manner can shape scientific understanding and development. This is a key component of the Yr7 course but maintains its influence throughout the years, whereby practical work and the gathering of evidence is undertaken periodically. Powerful core knowledge is knowledge very much linked to allowing students to have the tools and knowledge building blocks to be able to understand many of the 'big' ideas in science. However, to understand and then be able to apply and interpret ideas and concepts linked to such knowledge pupils

need to gain a solid understanding of often more discrete pieces of information from sometimes several topic areas. Some of those key topic areas to form a 'backbone' to allow understanding and progression within science form the basic core foundation knowledge.

How we sequence topics to create a logical, coherent, narrative.

All pupils start with the introduction to practical science and the scientific method. This work is then consistently revised and revisited throughout the rest of the curriculum.
KS3 lays the foundations for all the major topic areas at GCSE as pupils gain increasing insights to knowledge that often repeats then builds as they move through the course.
An example may be: Yr 7 pupils are introduced to matter and the 3 states and particle pictures. Basic change of state ideas introduced. In Yr 8 this is revised and the use of kinetic theory to describe state changes is a key feature. Basic interpretation of cooling curve, change of state graphs are also introduced. Yr 9 (little in Yr 8 physics), basic atomic structure is introduced to replace the idea of particles as solid spherical balls. In Yr 10 the bonding and structure between atoms in solids, liquids and gases is introduced and used to link to the properties such as the melting and boiling points of the 3 states. This knowledge also compliments physics, who also build particle concepts until in Yr 10 pupils are explaining specific latent heat and cooling curve graphs.

Retention

How we secure mastery (long term retention) of powerful core knowledge

We follow the school approach of learn, practice, test (LPT)

As topics are taught, we build in low stakes testing mainly in the form of starters and some h/w tasks which will often contain recent, weeks ago and months ago threads and targeted questioning by the teacher. In addition, the Yr 7-9 core knowledge tests repeatedly test pupils understanding of the same key ideas and words so that their level of 'mastery' of the basics can continue in an ever upward trajectory. Each topic will have its own full topic test with a mix of multichoice, short and long answer questions testing knowledge, application and interpretation.

Vocabulary and Spelling

How we secure mastery of specialist academic vocabulary (T3 words)

The specialist academic vocabulary for each Yr 7/8 topic (tier 3 words) is given in knowledge organisers.
Key vocabulary is taught explicitly in the context of each topic and tested throughout in the assessment of academic essays and reading for meaning tests.

Core knowledge tests/topic tests require students to have good knowledge of specialist vocabulary. It is revisited and repeated as the curriculum builds and spirals to add more depth and detail that is often attached to tier 3 vocab, such a photosynthesis or reduction. Teachers emphasise the importance of specialist vocabulary in order to be able to write and communicate like a scientist.

How we secure mastery of vocabulary comprehension (T3 words in context)

Words are often broken down by the teacher (including into prefixes and suffixes) to illustrate their structure or links with everyday words. Examples are also given of how they can be used in actual sentences/correct context.

Reading for meaning tests in Yr 7 and 8 are set regularly to test students understanding of specialist vocabulary in context. The spiralling curriculum and use of starters/plenaries/hw/show me board revision, where these words are constantly being revisited helps with familiarity.

How we secure mastery of spelling (T3 words)

The spelling of specialist vocabulary is tested at the end of core knowledge tests in Yr 7 and 8.

Academic Writing

How we define writing like a Scientist

Experimental reporting and analysis generally follow the scientific method, although with time constraints it may be that certain aspects are emphasised and focused upon more in some practical's, leaving other aspects to be highlighted in another experiment. Predictions, method or plan, valid testing, independent/dependent variables highlighted, design of results tables, analysis including graphs and calculations, conclusions, explanations and evaluations are all revisited throughout in science. Being concise and clear is key in science.

Writing precise and concise answers for the award of up to 6 marks in 1 single answer is explicitly taught with an emphasis especially from Yr 9 onwards on use of key trigger words such a s describe, explain, evaluate.

How we teach academic writing in Science

Teachers may use Visualisers to model the correct approach to tackling certain longer questions and how to distil what needs to be included and what doesn't.

In the academic essays, they receive instruction on how to set out and construct their answer with suggested vocabulary to include.

We explicitly teach how to respond to key trigger words in science longer answer questions (6 marks max). Eg explain, describe, evaluate being most common.

Independent Learning (Prep)

Regularity

Year	Frequency	Hours per week or term	Main form or types
7	Approx ½ pieces per 2 weeks.	Varies but approx 1 hr per 1/2 weeks	Term 1 h/w booklet is set and in around October half term. Following this, pupils are set small tasks, spellings, recall worksheets, as and when appropriate to consolidate learning and for topic test preparation.
8	Approx 1 piece per 3-4 lessons	30 min per subject per 2 weeks approx	Worksheets to consolidate knowledge, practice revision questions.

9	1 to 2 pieces every 2 weeks	1 hour every 2 weeks	Worksheets to consolidate knowledge, practice revision questions
10	Typically, 1 piece a week/2 weeks, though this may vary.	6 hours per 6 week term.	Exam style questions, revision tasks, learning lists
11	Typically, 1 piece a week/2 weeks, though this may vary.	6 hours per 6 week term.	Exam style questions, revision tasks, learning lists

Assessment

How we assess progress at KS3

Progress is assessed by the following

Core knowledge tests
Spelling tests
Reading for Meaning tests
Academic essays
Regular topic tests
Teacher knowledge following the constant feedback from groups as they are taught. Eg starters/low stakes test/show me boards
At Easter of Yr 9 pupils sit 'Progress exams' in the hall to help decide their GCSE pathway.

In year 7, 8 and 9 students are assessed via a SAGE grade (Scholastic Excellence, Advanced, Good, Emerging). This can be compared with what their baseline assessments from Primary and our own school testing suggest where the pupil should be at.
This information is reported to parents three times a year in progress reports and further explained at parents' evenings.

How we assess progress at KS4

Progress is assessed by the following
Regular topic tests at Foundation and Higher levels
Exams in main hall
Class based assignments
Prep
Low stakes tests and the constant feedback from the class and its response as a whole 'feel' and from individuals.

GCSE grading is used to calculate current working grades (CWG) and projected performance grades (PPG).

Teaching and Learning

How we teach to the top

Pupils are taught in mixed ability groups (apart from a single smaller supported group that is sometimes set up should timetabling and numbers allow it) to the end of KS3, with all pupils having exposure and access to the higher material. Instruction and resources are provided to ensure that pupils receive the scaffolding they need to reach that level where possible. Targeted questioning is used to check the understanding of the students and whole class feedback includes reminders of basic knowledge, concepts and vocabulary. This means we usually take a 'no hands' approach to questioning to avoid currently more able students potentially dominating and giving a false impression of the general level of understanding of the class.

The mastery approach means students' knowledge is constantly reinforced and staff have the desire and belief that all students can reach or exceed their potential.

We also celebrate intellectual curiosity, never talk down our own knowledge nor make a virtue of our ignorance. We never use terms like 'gifted and talented', instead attributing progress to effort and deliberate practice and hard work.

How we ensure topics are introduced with direct instruction

For each topic we start big and go small. In other words, the teacher establishes the big picture and provides a general overview before moving on to detail and specific discrete areas, reminding and building from previous aspects of the curriculum as we move forwards.

Cultural Capital

How we develop cultural capital

Pupils with higher levels of science capital in their family are more likely to aspire towards a science-related career compared with pupils with lower levels of science capital. Science cultural capital must mean that all pupils regardless of background have the same opportunities at Casterton to follow higher or triple paper courses, go on science visits or take part in STEM days or assist at open evenings etc.
To that end science is taught in mixed ability groups (apart from sometimes a single smaller supported group) right the way through to after Easter of Yr 9 and then in broadly banded higher and foundation groups with movement between groups possible when required. We encourage and foster a belief that as many pupils as possible can do higher paper material. Due to staffing and timetabling constraints the separate triple science pathway cannot always be offered to as many pupils as we would like.
Science is littered with examples of great achievements by people from humble backgrounds and this is highlighted as and when appropriate. (eg Mendeleev and the fact that his father became blind and died before he was 14, his mother with up to 14 children made sacrifices to travel to St Petersburg to get Mendeleev into a university). In addition, the relevance of science to people in their everyday lives is important to acknowledge as are any issues around gender stereotypes and science subjects and jobs.

Additional Notes

Staffing

Head of Department	Mr J Pears

Deputy Head (where appropriate)	Mr R Paton Biology/Chemistry
Teaching Staff (specialism where appropriate)	Mr Pears Chemistry Mr Mangham Chemistry Mrs Sanders Chemistry Mrs Taylor Sneddon Biology Miss Weid Biology Mrs Bryjova Biology Mrs Howarth Biology Mr Astles Physics Mr Bristow Biology
Senior Link	N. Rawes