

Sciences Department Curriculum Statement



Intent

In science we aim to:

- develop **inquiring minds** and **curiosity** about science and the natural world
- **acquire knowledge**, **conceptual understanding** and **skills** to **solve problems** and **make informed decisions** in scientific and other contexts
- develop skills of **scientific inquiry** to **design** and **carry out** scientific investigations and **evaluate** scientific evidence to draw conclusions
- **communicate** scientific ideas, arguments and practical experiences accurately in a variety of ways
- think **analytically**, **critically** and **creatively** to **solve problems**, **judge arguments** and **make decisions** in scientific and other contexts

The curricula we offer not only underpins the IB learner, but that of the schools values of Intellect, Empathy and Courage.

Implementation

a) Content & Skills

In Science we implement a curriculum that has been designed to ensure that both **knowledge of procedures and concepts** are developed throughout their time at Bexley Grammar School. The key goal of our Science Curriculum is to deliver **engaging lessons** that would produce students that **know and understand the key ideas of science**. The students would be equipped with the tools to work scientifically; **analyse**, **communicate**, **enquire** and **solve problems** with confidence. The seven years of study are based around a **spiral curriculum**: a student will meet each fundamental concept multiple times throughout their school career, with each encounter increasing in complexity and reinforcing their previous learning.

In 2021- 2022 a new scheme has been introduced at Year 7 and 8 titled 'Exploring Science' which focuses on the skills mentioned and on **safety** and **disciplinary literacy**. In Y9-11 students follow the OCR 9-1 Gateway Separate Science Award specification. In the sixth form the IB the following courses are offered at Higher level: Biology, Chemistry and Physics. At Standard Level the following courses are offered; Biology, and Environmental Systems and Societies. A new IB specification will be introduced in the Sciences in 2023. The sequence of teaching is set out in a logical and hierarchical order, commencing in fundamental concepts and then progressively expanding to global concepts.

Biology

In Biology students study living organisms and how they interact with the world around them. In order to gain an in-depth understanding of the living world, studies are conducted at the molecular level within cells, building up to tissues, organs and organ systems and then studying whole organisms and how they interact in ecosystems.

Year 7-8	Year 9-11	Sixth form HL and SL
Cells, Tissues, Organs & Systems Sexual Reproduction Muscles & Bones Ecosystems Food and nutrition Plants and their reproduction Breathing and respiration Unicellular organisms	B1: Cell level systems B2: Scaling up B3: Organism level systems B4: Community level systems B5: Genes, inheritance and selection B6 Global challenges B7 Practical skills	Core 1: Cell Biology 2: Molecular Biology 3: Genetics 4: Ecology 5: Evolution and Biodiversity 6: Human Physiology Additional higher level (AHL) 7: Nucleic Acids 8: Metabolism, Cell Respiration and Photosynthesis 9: Plant Biology 10: Genetics and Evolution 11: Animal Physiology Option C: Ecology and Conservation Practical scheme of work Practical activities Individual investigation (internal assessment—IA) Group 4 project

Chemistry

Chemistry is often considered to be the central Science being used to explain the complex reactions that occur in biological systems as well as explaining why materials behave in a certain way. The course covers the traditional aspects of Chemistry as well as exploring the concepts of Green Chemistry and sustainable development. Chemistry allows students to understand why and how things happen in the world around them and gives some understanding of how it can be used to help shape a better future world.

Year 7-8	Year 9-11	Sixth form HL only
Safety Mixtures and Separation Acids & Alkalis Particle model Atoms, Elements & Molecules Combustion The periodic table Metals and their uses Rocks	C1 Particles C2 Elements, compounds and mixtures C3 Chemical reactions C4 Predicting and identifying reactions and products C5 Monitoring and controlling chemical reactions C6 Global challenges C7 Practical skills	Core: 1. Stoichiometric relationships 2. Atomic structure 3. Periodicity 4. Chemical bonding and structure 5. Energetics 6. Chemical kinetics 7. Equilibrium 8. Acids and bases 9. Redox processes 10. Organic chemistry 11. Measurement and data processing Additional higher level (AHL) 12. Atomic structure 13. The periodic table—the transition metals 14. Chemical bonding and structure 15. Energetics/thermochemistry 16. Chemical kinetics 17. Equilibrium 18. Acids and bases 19. Redox processes 20. Organic chemistry 21. Measurement and analysis Option D: Medicinal chemistry Practical scheme of work Practical activities Individual investigation (internal assessment—IA) Group 4 project

Physics

Physics is the most fundamental of the experimental sciences, as it seeks to explain the world in which you live. It deals with matter and energy and how they interact, looking at objects ranging from the very small to the entire universe.

Year 7-8	Year 9-11	Sixth form HL only
Energy Electricity Sound Forces Fluids Light Energy Transfer Earth and Space	P1: Matter P2: Forces P3: Electricity P4: Magnetism and magnetic fields P5: Waves in matter P6: Radioactivity P7: Energy P8: Global challenges P9 Practical skills	Core 1. Measurements and uncertainties 2. Mechanics 3. Thermal physics 4. Waves 5. Electricity and magnetism 6. Circular motion and gravitation 7. Atomic, nuclear and particle physics 8. Energy production Additional higher level (AHL) 9. Wave phenomena 10. Fields 11. Electromagnetic induction 12. Quantum and nuclear physics Option D: Astrophysics Practical scheme of work Practical activities Individual investigation (internal assessment—IA) Group 4 project

Environmental Systems and Societies

Students develop a wide range of skills during the environmental systems and societies course including practical skills, use of statistics, interpreting, analysing and evaluating information, graphical skills, working systematically, considering opinions and values and independent thinking whilst developing a scientific and ethical understanding of environmental issues and sustainability.

Sixth form SL only	
1. Foundations of environmental systems and societies 2. Ecosystems and ecology 3. Biodiversity and conservation 4. Water and aquatic food production systems and societies	5. Soil systems and terrestrial food production systems and societies 6. Atmospheric systems and societies 7. Climate change and energy production 8. Human systems and resource use
Practical scheme of work Practical activities	Individual investigation (internal assessment—IA)

b) Learning environment

The department is very well resourced and consists of 13 members of teaching staff. The department is supported by a team of 6 laboratory technicians, led by a senior technician. There are 12 laboratories which are in general arranged for specialist teaching at KS5, these are each well decorated with informative, useful display work and resourced a variety of teaching aids including interactive whiteboards and whiteboards. Data-logging is used to investigate concepts introduced during courses, and class sets of chromebooks are available to ensure that all students can take part in these activities.

Expectations of behaviour in laboratories are reinforced through the department code of conduct and safety rules. In addition to the schools ' non-negotiables which are displayed in all laboratories.

Homework is an important part of learning and is used to reinforce and practice concepts, skills and knowledge learned in class. It is also used on occasions for students to research in preparation for the next lesson. This includes quizzes, Seneca online platform, and extended writing. Students throughout the key stages take part in extracurricular activities, details of these activities can be found in the last section of this document.

c) Assessment & Feedback

Assessment:

Assessments for all year groups 7-11 take place half termly, with results recorded centrally. Assessments for the sixth form are taken after each unit of work and results are recorded centrally to monitor progress.

Students receive written and verbal feedback on a regular basis indicating what they need to do improve. Moderation of 6 mark answer questions and Internal Assessments are undertaken.

Student record sheets are also used to assess progress, and suggest areas for improvement, with students and teachers setting relevant targets to help improve their work.

Feedback:

Students in Years 7 and 8 are given progress trackers, which are updated with grades and targets based on areas for improvement, this allows them to reflect after mini topic tests, subject tests, and end of year examinations. These sheets are to be found at the front of their exercise books.

Students in Years 9-11 are given record sheets and in Years 12 and 13 are given electronic target sheets respectively. Students are encouraged to identify their weak areas in order to rectify them through targeted review, and revision.

At all key stages student progress is tracked through assessment marks, and grades recorded on tracker sheets on Google drive. In addition to individual support by class teachers, students are selected using this data for intervention clinics.

d) Monitoring

There is a centralised system of assessment spreadsheets across all year groups, which are monitored by the Head of Science and three Subject Leaders, and used to inform intervention. Reports are also monitored for consistency between classes.

Learning walks and lesson observations are carried out by the head of department and subject leaders to monitor quality of teaching and learning. Work scrutiny is carried out in department meetings. Results of individual teaching groups are compared to identify any under or over performing groups.

All teachers maintain Context Sheets for latest SEND data, and these are centralised so the HoD and subject leaders can monitor and support differentiated provision and personalisation. Intervention clinics continue to be held, where science prefects support targeted students to mentor and support those students identified by the subject leaders and their subject teachers. This, in addition to personalisation strategies to be used in class by their subject teacher. Those students who are the most able are stretched and challenged through extension work, through material to 'read around' the subject, and through extra curricular activities such as science and STEM clubs and through visits, lectures and competitions such as the sixth form Olympiads, and the KS3 Salters Chemistry Festival competition.

In Year 10 in the second half of summer term 2021, a small group of 50 students were invited to attend 'catch up' sessions. Twenty four students were selected to attend hour-long sessions in biology, chemistry, and physics for a period of 4 weeks. These sessions were led by specialist science teachers.

Impact

In 2022, IB performance in Higher Biology was in line with school targets (50 entries, L7-6: 44.0% and L7-5: 82.0%, with an average point score (APS) = 5.44 which is above the world average of 4.72).

IB performance in Higher Chemistry in 2022 was in line with most school targets (39 entries, L7-6: 43.6% and L7-5: 69.2%, with an APS = 5.21 which is above the world average of 4.98)

IB performance in Higher Physics in 2022 was in line with school targets (46 entries, L7-6: 52.2% and L7-5: 87.0%, with an APS = 5.59 which is above the world average of 5.09)

IB performance in Standard Biology in 2022 was in line with some school targets (20 entries, L7-6: 25.0% and L7-5: 70.0%, with an APS = 5.05 which is above the world average of 4.56)

IB performance in Standard Physics in 2022 was in line with school targets (12 entries, L7-6: 66.7 and L7-5: 75.0%, with an APS = 5.92 which is above the world average of 4.64)

IB performance in Standard Environmental Systems and Societies in 2022 was in line with school targets (65 entries, L7-6: 40.0% and L7-5: 80.0%, with an APS = 5.28 which is above the world average of 4.64)

Outcomes in the Science department are very favourable when compared to national standards in terms of attainment and progress. The Sciences are incredibly popular in the Sixth Form with an average of 110 students studying at least one of the IB Higher in Biology, Chemistry or Physics. We have had great success with students progressing to prestigious universities to study Science based subjects, such as Medicine, Veterinary Medicine, Dentistry and Engineering.

All students studied all three GCSE separate sciences. In 2022, the sciences have gained a higher average point score than any other Ebacc subject (average of 2 best science grades = 7.74).

GCSE performance in Biology Separate sciences in 2022 was above the school targets (189 entries, L9-8: 56.1%, L9-7: 79.9% (Nationally L9-7 = 49.8%) and L9-5: 99.5% with an APS = 7.56).

GCSE performance in Chemistry Separate sciences in 2022 was above the school targets (189 entries, L9-8: 53.6%, L9-7: 75.1% (Nationally L9-7 = 49.6%) and L9-5: 98.4% with an APS = 7.47).

GCSE performance in Physics Separate sciences in 2022 was above the school targets (189 entries, L9-8: 56.6%, L9-7: 76.2% (Nationally L9-7 = 50.3%) and L9-5: 99.5% with an APS = 7.53).

We have also been a member of the Prince's Teaching Institute Research Programme for the last decade, an association which has offered several members of the department the opportunity to run projects that are beneficial to themselves professionally and to their students, including our current target focussing on the extracurricular opportunities provided in Science.

The department provides a range of opportunities for students to develop their interest in the subject outside lessons, with our annual highlight celebrating British Science Week. Our Year 9 and 10 students created a Periodic Table mural to celebrate 150 years since the Periodic Table was developed by Dmitri Mendeleev. This was selected for display in a photographic competition organised by the Royal Society of Chemistry Kent, and was displayed in a Whitstable Art gallery. The periodic table is now constructed in the stairwell near the main building.

Below is a range of the extracurricular opportunities we provide in Science for 2022:

[illegible]

	Competitions			STEM House Competition, OUCC challenge			
	Extra		STEM Power Day		British Science Week activities		
10	Regular Clubs	Engineering Club	Engineering Club	Engineering Club	Engineering Club	Engineering Club	Engineering Club
	Competitions			STEM House Competition, OUCC challenge			
	Extra		STEM Power Day		British Science Week activities		
11	Regular Clubs	Arkwright Scholarship Prep	Arkwright Scholarship Prep				
	Competitions			Intermediate Maths Challenge - 1st Feb 2023			
	Extra				British Science Week activities		
12	Regular Clubs	Science Leaders Support lower school clubs Quantum Club	Science Leaders Support lower school clubs Quantum Club	Science Leaders Support lower school clubs	Science Leaders Support lower school clubs	Science Leaders Support lower school clubs	Science leaders run science clubs at primary schools (weekly for six weeks)

	Competitions	ICE Engineering Competition	ICE Engineering Competition	Cambridge Chemistry Race Chemistry Olympiad, Mars Balloon		Intermediate Biology Olympiad	Chemistry Cambridge Challenge
	Extra	Empowering Females in STEM Course	Diversity In STEM Black History Month talk	Operating Theatre Live	In Action Careers Conferences British Science Week activities	I'm a Scientist Careers Talks	
13	Regular Clubs						
	Competitions	Senior Maths Challenge - 4th October 2022		Chemistry and Biology Olympiad			
	Extra		Diversity In STEM Black History Month talk	Spectroscopy Trip	In Action Careers Conferences		