Wave Trust
Science Curriculum

Our Trust curriculum is underpinned by our WAVE values, which also serve as powerful and unique drivers for our curriculum:

Be positive: We have the highest expectations of what our pupils are capable of, no matter what their starting points, and no matter how many fresh starts. Through our Curriculum offer, we will strive to develop unique talents; build confidence; character, aspiration; attainment and at KS4, also qualifications. We aim to prepare pupils for their next steps, and life in modern Britain. We believe every child can learn to read.

Have empathy: We seek first to understand, then to be understood. Through our curriculum, we will develop empathetic learners who have an awareness, understanding and are considerate of themselves; their peers; our communities; as well as of the world around us all.

Show respect: Our curriculum will support of students to respect themselves, each other and teach an understanding and awareness of diversity.

Work as one team: Our curriculum gives our students opportunities to work collectively together, through opportunities to talk, listen, and create. We will draw on every opportunity for learning, both planned and unplanned, to develop pupils' ability to reflect, engage and relate positively to one another.

Be inclusive: We will strive to ensure our curriculum is accessible and meets the needs of all our learners. Not one size fits all, but skilfully adapted to meet individual need and SEND/SEMH need.

Science Intent

Our Science curriculum from Key Stage 1 to 4 is premised on the National Curriculum.
Science will deepen specific scientific skills and knowledge to ensure that pupils develop the scientific, environmental and social awareness to become informed members of the local and global community. We want our students to be equipped with the scientific skills required to understand the uses and implications of science, today and for the future.
Our curriculum will enable children to become enquiry based learners collaborating through researching, investigating and evaluating experiences. It will encourage respect for living organisms and for the physical environment.

Teachers will ensure that all pupils are exposed to high quality teaching and learning experiences. These will hook the pupils' interest, enabling them to develop a sense of excitement and curiosity about natural phenomena. They will be encouraged to ask questions about the world around them and work scientifically to further their conceptual understanding and scientific knowledge.

Pupils will be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes. It will provide opportunities for the critical evaluation of evidence and rational explanation of scientific phenomena as well as opportunity to apply their mathematical knowledge to their understanding of science, including collecting, presenting and analysing data. Pupils will be immersed in key scientific vocabulary, which supports in the acquisition of scientific knowledge and understanding

In our Wave AP Academies, we want to reengage pupils in science and be able to return to mainstream, or their next school, with sufficient component knowledge to keep up with their peers.

We are not WHOLE THROUGH provision, and it is exceedingly rare that pupils with us in Primary AP transfer to Secondary AP. However, the Primary and Secondary phases prepare pupils mindful of prior experiences and future learning, in whatever setting they come from or return to, so that no pupil is disadvantaged.

Our curriculum is thus designed very much with the journey and destination in mind, enabling teachers to take account of prior learning, and support progress and engagement.

Secondary Science
Key Stage 3

At Secondary, we build on the Primary Curriculum. It is important to state that pupils do not stay with us from Primary to Secondary except in very rare circumstances.
Assessment at the start of each topic plays a key role, where pupils join us in the Regional Academies with different levels of prior learning. At the Trust, we have developed a central Science Curriculum in order to support teachers' planning. This is called 'Lilypads'.
Wave students in the Regional Academies are taught in mixed ability/age KS3 classes due to our small numbers, and may have Science lessons up to 3 lessons a week where accessing the core timetable, though Principals determine this. This presents a challenge and opportunity to curriculum design. Pupils arrive with very different experiences and prior learning. 'Sufficient cumulative component knowledge' underpins our Science Trust Curriculum intent in supporting pupils move forwards from their unique starting points.
Students at the APs are not usually in the same setting for their entire 3 years of KS3. Students commonly enter and leave at any time throughout the Key Stages.

Audit, both internal and external through the Cornwall and Devon Science Learning Partnership in 2021 reflected that KS3 schemes were too large and students had gaps in their knowledge, so it was difficult to teach the schemes. We therefore worked with Ed Walsh, External Science Consultant and author of Collins Ket Stage 3 Science schemes, to create the Lily Pad scheme. LilyPads was developed to be the Wave KS3 Science Curriculum, with the support of an External Science Consultant. There are different pathways through the scheme depending on the student's knowledge however there is a core of non-negotiable objectives in each LilyPad

It is important though that students have access to all of the KS3 PoS, as they will otherwise be at a disadvantage when they go back to mainstream. Therefore, the LilyPads Benchmark Curriculum covers the vast majority of the KS3 Programme of Study (Subject Content and Working Scientifically) through the three pathways, this is shown in the mapping document. Staff create their own planning through this long-term overview set out here, around the needs of their classes.

Assessment in Science

Pupils are assessed on entry and at the start of each Unit below and teachers use this data to inform their teaching and planning. Pupils attainment is tracked formatively throughout the unit using a Formative Tracking tool which enables teachers to keep a granular track of how well pupils are learning the curriculum, and can inform transitions.

LilyPad KS3 Long Term Plan

LilyPad	Date	Subject Content (LilyPad A, B or C) and Big Ideas
P1 (Energy)	**Autumn 1**	Energy costs, Energy transfers, Waves, Electricity & Magnetism **Big Idea: Energy is conserved, Electricity transfers energy, Radiation transfers energy, Fields produce forces**
C1 (Particles)	**Autumn 2**	Particle model, ECM, pure & impure substances (separation techniques), Periodic Table ***Big Ideas: Structure determines Properties, Reactions rearrange matter***
B1 (Cells & Systems)	**Spring 1**	Cells, Skeleton & muscles, Nutrition & Digestion, Gas Exchange, Reproduction & Health ***Big Ideas: Cells are alive, Bodies are systems***
C2 (Earth)	**Spring 2**	Materials (metals & non-metals), Chemical Reactions, Energetics, Earth & Atmosphere **Big Ideas: *Reactions rearrange matter, Earth systems interact***
B2 (Ecosystems & Genetics)	**Summer 1**	Photosynthesis, Respiration, Ecosystems, DNA & Inheritance, Variation **Big Ideas: Species show variation, Characteristics are inherited, Cells are alive**
P2 (Forces)	**Summer 2**	Forces (friction, balanced forces, motion), Pressure, Density, Space Physics **Big Ideas: Forces predict motion, Fields produce forces, Energy is conserved**

LilyPad Journey

1. Students take baseline test (either written or teacher led) to decide which LilyPad they will follow (A, B or C). The LilyPad journey is not fixed so students can jump between LilyPads during the half term depending on their knowledge.

2. Each lesson is based around an objective – with the non-negotiable objectives taking priority. Formative assessment of those objectives throughout the module through low stakes testing (Quizizz, Seneca, footprints) is carried out. Working Scientifically is embedded into each module and the progression can be seen using the mapping page.

3. Student progress is recorded as the module is taught on LilyPad progress grid. This formative assessment is used to inform teaching and is not meant to be summative. The progress grid can be passed to the new school when the student leaves the centre.

4. Students given an end of module assessment (LilyPad A, B and C tests available) as a summative assessment. This is available as a written and Quizizz version.

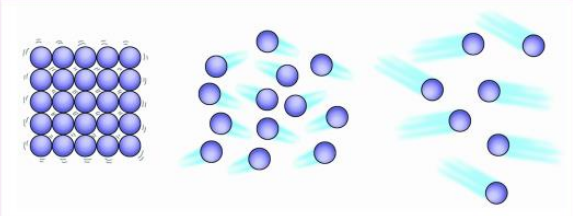
Teachers will find the long-term plan in more detail on the Science SharePoint.

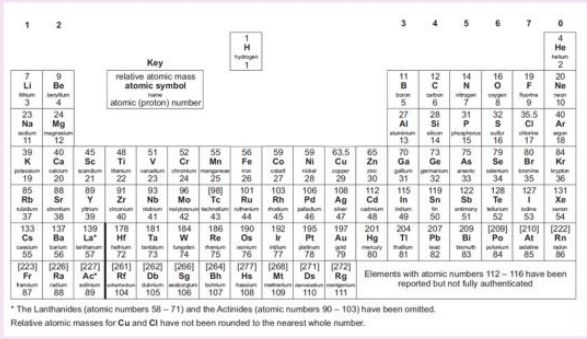
Pupils having opportunities in terms of Working Scientifically is mapped out here, and teachers will plan to support learning of these strands so that pupils know and understand what it means to think and work as a Scientist.

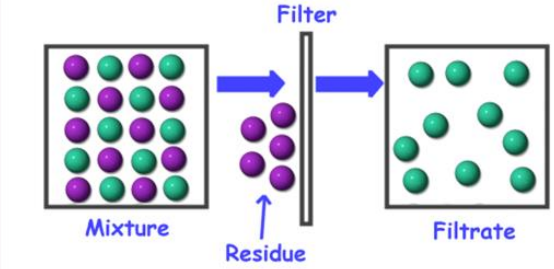
LilyPads Working Scientifically Mapping		Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
Code	N.C Subject Content	P1 Energy	C1 Particles	B1 Cells & Systems	C2 Earth	B2 Ecosystems & Genes	P2 Forces
WS1.1	pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility	A, B & C	A, B & C	B & C	A, B & C	B & C	A, B & C
WS1.2	understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review	C	B	A & C	A, B & C	C	A, B & C
WS1.3	evaluate risks.	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C
WS2.1	ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience	B & C	B	A, B & C	B & C	B & C	A, B & C
WS2.2	make predictions using scientific knowledge and understanding	B & C	B & C	B & C	C	B & C	A, B & C
WS2.3	select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate	B & C	B	B & C	B	B & C	A, B & C
WS2.4	use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C
WS2.5	make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements	A, B & C	B	B & C	B	A, B & C	A, B & C
WS2.6	apply sampling techniques.			A & B		C	
WS3.1	apply mathematical concepts and calculate results	A, B & C	A, B & C	A, B & C	A, B & C	B & C	A, B & C
WS3.2	present observations and data using appropriate methods, including tables and graphs	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C
WS3.3	interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C
WS3.4	present reasoned explanations, including explaining data in relation to predictions and hypotheses	B & C	B & C	B & C	B & C	B & C	A, B & C
WS3.5	evaluate data, showing awareness of potential sources of random and systematic error	B & C		C	C	B & C	B & C
WS3.6	identify further questions arising from their results.	B & C	B	B & C	B & C	B & C	B & C
WS4.1	understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C	A, B & C
WS4.2	use and derive simple equations and carry out appropriate calculations	A, B & C		B		C	A, B & C

Examples of Autumn term's Particles Curriculum Overview is set out here. All 6 Units follow a similar format. Teachers take account of prior learning, and plan around needs of individuals, creating meaningful sequences and outcomes. The 3 lily pads enable a Year A and Year B, to increase depth, breadth and stretch when revisiting 'Particles' for example, so that pupils who remain in an AP KS3 class for longer than a Year do not repeat content:

Autumn 2
C1 Particles







Big Ideas

Structure determines properties

Reactions rearrange matter

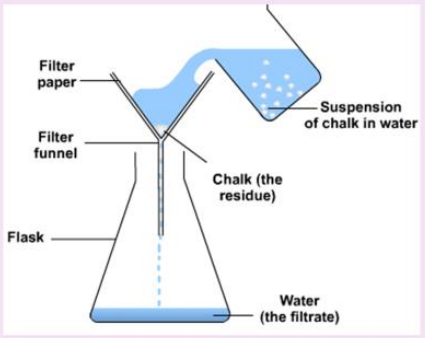
Topics

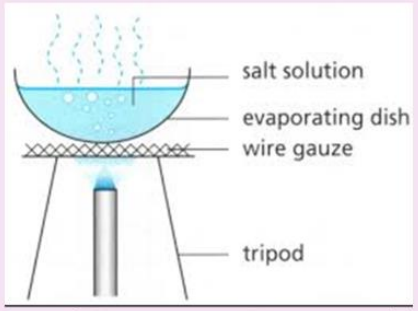
Particle model

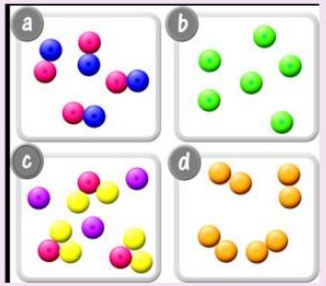
Elements, Compounds & Mixtures

Pure & impure substances (separation techniques)

Periodic Table







Particle Model – LilyPad A (Non-negotiables in bold) Students can…

2A – Particle Model A Objectives	Suggested Activities & WS
2.A1 Describe the properties of solid, liquid and gas in terms of particles	Draw and identify diagrams of S,L,G
2.A2 Describe the changes of state in terms of particle movement	Worksheet
2.A3 Prepare a table to record results, use the measuring equipment correctly and represent results on a suitable graph	Use a Bunsen to heat substance, take temperature, record results in table, calculate an average and draw a graph.
2.A4 Identify and describe the properties of Elements, Compounds & Mixtures	Use particle diagram to classify ECM Iron and sulphur practical
2.A5 Identify the symbols for common elements	H, O, N, C, Zn, Fe, Cu, S, I, Al, Br, Cl, Mg, Na, K, Ag, Au
2.A6 Describe the Structure of periodic table, identifying metals, non-metals and the names of the main groups	Worksheet
2.A7 Name compounds using chemical formula showing number of atoms and elements in a chemical substance	Worksheet – Numbers of atoms and elements in a compound
2.A8 Explain how solutions are made	Recap Diffusion. Jolly Jelly activity
2.A9 Describe and carry out method to separate an insoluble solid from a soluble solid	Practical - Separating sand and salt (filtration and evaporation)
2.A10 Describe and carry out method of how to separate different coloured substances using Chromatography	Practical - Pens and ink, skittles and water,
2.A11 Describe and carry out method of how to separate two soluble substances using Simple distillation	Practical - how you can get pure water from ink solution

Particle Model – LilyPad B (Non-negotiables in bold) Students can…

2B – Particle Model B Objectives	Suggested Activities & WS
2B.1 Explain gas pressure in terms of particles	Worksheet. Blowing up balloons demo
2B.2/3 Explain the changes in state in terms of changes to the energy of the particles.	Find the melting point of salol by collecting data and plotting a graph. Graph Worksheet
2B.4 Represent atoms, molecules and elements, mixtures and compounds using particle diagrams.	Worksheet, coloured circles to make compounds
2B.5 Use observations of a pattern in chemical reactions to predict the behaviour of an element in a group	
2B.7 Given chemical formulae, name the elements present and their relative proportions.	
2B.8 Use the solubility curve of a solute to explain observations about solutions.	Dissolving / saturation investigation
2B.9 Choose the most suitable technique to separate out a mixture of substances	How much salt can you get out of rock salt? Investigation / competition
2B.10 Use evidence from chromatography to identify unknown substances in mixtures	
2B.11 Explain how two soluble substances with different boiling points can be separated using Simple distillation	Practical - how you can get pure water from ink solution

Particle Model – LilyPad C (Non-negotiables in bold) Students can…

2C – Particle Model C Objectives	Suggested Activities & WS
2C.1 Predict whether a compound or element is S, L or G at different temperatures using boiling and melting point data.	**Worksheet**
2C.2 Describe and explain the changes that occur in the particle arrangement as shown in heating and cooling curves	**Worksheet Practical for heating or cooling curve**
2C.3 Describe the structure of an atom including the sub-atomic particles	Worksheet
2C.4 Compare and contrast the properties of elements and compounds and justify a reason for these differences.	Worksheets
2C.5 Predict the position of an element in the Periodic table based on information about its physical and chemical properties.	Worksheet and Test base questions
2C.8 Analyse and interpret solubility curves	Worksheet and Test base questions
2C.9 Suggest a combination of methods to separate a complex mixture and justify the choices.	**Practical: Separating Iron and pure salt from shipwreck (iron and rock salt)**
2C.10 Use evidence from chromatography to calculate Rf values.	**Chromatography - calculate Rf values.**
2C.11 Explain how two soluble substances with similar boiling points can be separated using Fractional Distillation	Practical – how many of the fractions can you get out of cherry coke?

Particles- Working Scientifically Autumn 2

2A – Particles A	2B - Particles B	2C – Particles C
2A3 – Practical – Bunsen Skills ***WS 1.1, 1.3, 2.4, 3.1, 3.2, 4.1, 4.3***	**2B1/2 – Practical – Melting Point of a Solid** ***WS 1.1, 1.3, 2.2, 2.4, 3.1, 3.2, 3.3, 4.1, 4.3***	**2C2 – Practical – Describe and Explain what happens when a solid melts and boils** ***WS 1.1, 1.3, 2.2, 2.4, 3.1, 3.2, 3.3, 4.1, 4.3***
2A4 – Practical – Mixing Iron and Sulphur *WS 1.3, 2.2, 2.4, 3.3*	**2B8 – Investigation – Factors affecting solubility** ***WS 1.1, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 3.2, 3.4, 3.5, 3.6, 4.1, 4.3***	**2C9 – Investigation - Separating Iron and pure salt from shipwreck (iron and rock salt)** ***WS 1.1, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 3.2, 3.4, 3.5, 3.6, 4.1, 4.3***
2A8 – Practical – Dissolving Jelly ***WS 1.3, 2.2, 2.4, 3.3***	**2B9 – Investigation – How much salt can you get our of rock salt** ***WS 1.1, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5, 3.2, 3.4, 3.5, 3.6, 4.1, 4.3***	**2C10 - Practical – Chromatography calculating Rf values** ***WS 1.1, 1.3, 2.4, 3.2, 3.3, 4.3***
2A9 - Practical – Separate insoluble from soluble solid ***WS 1.1, 1.3, 2.4, 3.2***	**2B10 - Practical – Chromatography** ***WS 1.1, 1.3, 2.4, 3.2***	**2C11 - Practical – Fractional Distillation of Cherry Coke** ***WS 1.1, 1.3, 2.2, 2.4, 3.2***
2A10 - Practical – Chromatography ***WS 1.1, 1.3, 2.4, 3.2***	**2B11 - Practical – Simple Distillation** ***WS 1.1, 1.3, 2.4, 3.2***	
2A11 - Practical – Simple Distillation *WS 1.1, 1.3, 2.4, 3.2*		

Each Science Lead will draw from the above overviews to plan their sequences of learning using the Trust proforma and based on accurate assessment of pupil's starting points in terms of prior learning. These schemes of learning show how the above knowledge is broken down into smaller sequenced steps and a secondary equivalent of 'I can' statements broken down. For example:

Granular Component Knowledge to support development of own schemes of learning

Week	Objectives	Outcomes	Resources /Activities	Key Vocabulary
1	**L1 - Describe the properties of solid, liquid and gas in terms of particles**	Draw diagrams to show arrangement of particles in solids, liquids and gases – Starter Explain how solids, liquids and gases behave differently because of how their particles are arranged. – Task 1 & 2 Explain how the behaviour of water particles are different in the three states – Task 3	Particles Student Booklet L1 Teachers Powerpoint Slides L1 Video - ScienceMonkey	Particles Solid Liquid Gas Vibration
	L2 - Describe the changes of state in terms of particle movement	Name the changes of state (Task 1) Describe evaporation and melting, linking to particle model (Task 2) Explain changes of state in terms of changes to the energy of the particles. (Task 3)	Particles Student Booklet L2 Teachers Powerpoint Slides L2 Video – Fuse School Animations Boiling and Melting (pbslearningmedia.org) Focus Education – Changes of state Essential Chemistry - Focus eLearning by Focus Educational Software ltd.	Melting Freezing Condensation Evaporation Sublimation

Key Stage 4
At Key Stage 4, our Regional APAs offer AQA GCSE Biology, and AQA GCSE Trilogy where pupils are with us for long enough and practical Lab facilities allow within the constraints of AP where facilities and technician support cannot operate in the same way as it would in a larger secondary school. In the context of other AP providers nationally, our GCSE aspiration and offer is notable. BTEC Science is also offered in some of our APAs where appropriate.

Science at River Dart Academy

This is where Science Leads and Primary Leads can add in details of their approach in terms of implementation/impact. This whole document will be uploaded to subject webpages, so there is no need to repeat the above Intent etc.

Aims and Learning Outcomes

In Science we aim for students to develop a sense of enjoyment and understand the relevance of Science. We encourage students to become confident learners in science through consistent approaches and expectations.

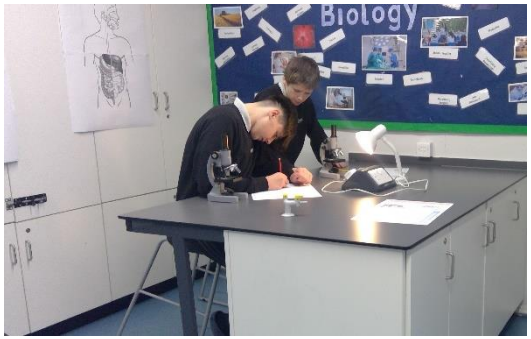
We aim to provide students with the skills to become scientific thinkers in and out of the educational environment. We strive to develop learners that know the foundations of the natural environment through the science of Biology. As such as KS4 draws to a close we envisage that our students will have gained an understanding of the natural world, and it is hoped that this interest will continue into adult life.

Students will understand how science is impacting on our lives and that of the environment, the animals around us and the complex and intertwined issues around the world's future such as, global warming including the essentiality of the biomass to support a healthy world. As a result, students will gain an understanding of the diversity and complexities of the natural world.

At key stage 4 we follow the GCSE Biology AQA course. Students will learn about:

1 Cell Biology
2 Organisation
3 Infection and response
4 Bioenergetics

5 Homeostasis and response
6 Inheritance, variation and evolution
7 Ecology
8 Key ideas



Assessment Objectives

Exams will measure how students achieve the following assessment objectives:

AO1: Demonstrate knowledge and understanding of: scientific ideas, scientific techniques and procedures
AO2: Apply knowledge and understanding of: scientific ideas, scientific enquiry, techniques and procedures
AO3: Analyse information and ideas to: interpret and evaluate, make judgements and draw conclusions, develop and improve experimental procedures