Curriculum Intent

1. **What is your faculty vision?**

Vision statement
All students to make better than expected progress and develop a lifelong love of science through an understanding of how science works.
We aim to achieve a progress score of plus 1 for all students

Explain how your curriculum would support students to have sufficient knowledge and skills for future learning & employment

- Science supports student literacy through access to challenging texts and supports their numeracy through the mathematical aspects of science, both of which are skills needed beyond DKA.
- They are taught skills to analyse, present and question data and to consider ways to agree or disagree using evidence.
- They are taught how to debate and express opinions on ethical issues in science without the use of emotive language to present a balanced argument, and to respond civilly when we may not agree
- They are taught the scientific method and the importance of accuracy and precision in data collection and how this may be achieved.
- The KS3 curriculum provides knowledge that will stretch and challenge students yet provide the fundamental science concepts and understanding on which to build for KS4. The theoretical content for each unit is determined by the trust cross cutting team which consist of all heads of science. We have added required practicals at KS3 to deliver the skills needed for working scientifically and ensure these are covered
- The KS4 curriculum is driven by the GCSE specification. All students do either double award or triple award which ensures students study science in depth rather than at the superficial level that a single science qualification would provide.
- The triple science provides additional academic rigour for our most able students.
- Both the triple and double award means all students can study science at a higher level and we are not closing opportunities for any of our students
- Building up from Y7 we are including a careers focus in all our Y7 units. There are ten units in Y7 and each has a careers focus that links to the scientific content delivered in that unit
- Some of our curriculum content has a direct link to specific careers, for example the electricity taught in KS3 and KS3 is relevant to those considering being an electrician, work on the units on heredity is relevant to those who may consider Genetic counselling as a career.

2. **How is your curriculum coherently planned and sequenced?**

Explain the rationale for how your curriculum is sequenced
Give examples from your curriculum overview documents for KS3 and KS4

- Science is taught as a series of Biology, Chemistry and Physics with each unit lasting approximately 3 weeks in both KS3 and KS4
- We interleave the Biology, Chemistry and Physics units rather than teaching a block of Biology, a block of Chemistry and a block of Physics. This allows students to see Science as one subject. Staff are explicit in making links between units of a science discipline and between units of different science disciplines.
- At KS3 our sequencing is determined by BEST evidence science research from University of York and by the trust. The BEST team identified the sequencing that supports the development of understanding of scientific principles within each subject. In their sequencing model, cell structure, the biochemistry within a cell, the nucleus and heredity should be taught prior to studying how the systems in the body

function and work. We have topics on cells and lifecycles in Y7 and then study cells to organ systems in Y8. In chemistry we study the particle model in solids and liquids and gases and then progress to particles in mixtures and separating techniques. Only then do we study atoms, elements and compounds which introduces atoms and molecules as particles Traditionally, the first topic taught in KS3 was cells. However, when we looked at this topic, they needed an understanding of diffusion which in turn needed an understanding of particles. It taught the reactions of photosynthesis and respiration which required students to understand elements and compounds, how new substances are made through chemical reactions and energy transfer. It is now taught in cycle 2 after the topics of energy, particles and solutions and elements and compounds have been delivered.

- Science skills is taught at the start of KS3 with the skills developed through meaningful practicals rather than learning to use equipment out of context
- In the trust units and content there was a unit at the end of Y8 called Pressure, Density and Moments We moved density to the start of Y7 in particles and solutions as this concept underpins many in science eg why sound travels faster in solids than gases. We moved pressure and moments to forces and motion to ensure the content was covered earlier and made sense in terms of sequencing.
- All units in KS3 have practicals that support the delivery of the content. The practical work supports making the abstract more concrete and makes links in the student's schema. There are eight investigations in each year to support the delivery of the scientific method and embed the key concepts of asking scientific questions, identifying variables, planning experiments to find out information, recording and analysing information, evaluating and improving our methods. There are other practicals that must also be delivered. For example the dissection of a flower to fully identify the different reproductive structures and the function of the enzyme amylase to see how starch is removed when the enzyme acts.
- In KS3, our physics units in Y7 do not involve calculations that change the subject of the formula. Liaising with the maths department has shown us that this is not taught until Y8. The methodology for how to change the subject of the formula is consistent in maths and science. We have adopted the method used in maths which does not use triangles and uses the balancing method
- Liaison with maths reduces the cognitive load on students. When modelling methods they are the same methods employed in maths. This is consistent across KS3 and KS4 and includes calculating gradients, drawing tangents and drawing line graphs.
- KS4 reviews and extends the concepts covered at KS3. We follow the AQA trilogy which examines through papers in Physics, Chemistry and Biology with the content divided into units within each discipline. Our more able students have the option for triple science. The triple science group consists of the 28 most able students in the year that have selected this as an option so as such the group does have a range of ability.
- We do not teach the subjects separately but interleave the units. P1 Energy is taught first as this topic underpins all three disciplines in science. B1 Cell biology is next followed by C1 Atomic structure and the periodic table. The units are not necessarily taught sequentially as some have more challenging concepts than others. B2 Organisation and C2 Structure and Bonding are taught next as they build on B1 and C2. However, P2 electricity is left until Y10. Instead P3 is taught as it covers the structure of matter which links with C1/C2 and it covers energy transfer when changing state and when increasing the temperature of a material that links with P1.

- There are required practicals that are specified by AQA, and these must be completed. Questions on required practicals account for 15% of examination across all papers. A consistent approach is adopted where the practicals are meticulously planned and are set-in real-life context, so students appreciate why they are completing them. They revisit and extend the working scientifically skills introduced at KS3. For example, at KS3 students will learn that we repeat readings and take a mean to eliminate random errors. At KS4 this is extended to cover random and systematic errors and reproducibility and repeatability of data.

3. What research, pedagogical approach or theory is your curriculum influenced by

Our KS3 curriculum was newly implemented in September 2019 and there is ongoing development of our KS4 curriculum. Both continue to be influenced by

- Best Evidence Science Teaching University of York Science Education Group
- EEF Improving Secondary Science Report
- Working with Big Ideas of Science Education
- AQA Science KS3 Syllabus
- ASE Science Skills age 11-14
- AQA specification at KS3
- Rosenshine's principles
- Efrat Furst and building schema
- Misconceptions in Science by Adam Boxer
- Learning scientists – six effective learning strategies
- Fiorella and Mayer's Generative Learning in Action by Mark and Zoe Enser

- Our holistic view is that we should deliver a science curriculum of intelligently sequenced units where students are taught links within and between the concepts through activities that develop their schema which is supported by Efrat Furst's research. This is within and across both key stages
- Common misconceptions are identified in schemes of work with suggestions for modelling to support making the abstract more concrete which is referenced in the Improving Secondary science guidance report
- New knowledge is introduced slowly and deliberately, with I do, we do, you do used as a scaffold prior to deliberate practice. This is particularly effective for calculations. This is referenced in Rosenshine's principles in order to manage cognitive load and embed practice
- Retrieval practice at the start of every lesson from a topic previously taught helps to embed knowledge and elaboration activities through the Do now help embed this knowledge for easier recall later.
- Recall of previous learning from the lesson and using this to build a mind map supports retrieval as identified by Rosenshine and builds schema as highlighted by Furst.
- We have revision lessons following the same format for each unit at KS3 in Y7 to support recall through brain dump activities, ask students to identify misconception and correct incorrect statements, and create sentences from key words. The format of these revision lessons was influenced by the work in Generative learning in action which identified the most effective strategies for transfer of information to long term memory.
- The use of stories at KS3 puts each unit in context and supports students in seeing science as an ever-changing continuum going back often thousands of years where ideas have changed and developed. It also allows them to see how little some ideas have changed, for example Newton's Laws which are still studied today to explain the motion of objects
- The OFSTED review highlights the importance of delivery the disciplinary and substantive knowledge in a cohesive way. The substantive knowledge is clearly identified in a sequence to develop understanding as referenced earlier. The disciplinary knowledge is equally planned across both key stages and is delivered alongside the substantive knowledge. Science needs both to well planned as both are required to have a full and well-rounded understanding of science and how it works
- Over the two key stages we deliver a spiral curriculum model. Content is revisited but building on and deepening understanding through doing this. An example is learning about atoms, and elements in Y7, then in Y8 this is revisited and moved forward in the chemical reactions unit when we study how compounds are made. In KS4, this is revisited again and taken further to learning about ion formation and how ions form compounds in chemical reaction. This is revisited again in electrolysis where an understanding of atoms and ions is further developed when looking at the discharge at electrodes.

When planning the curriculum it is important as teachers to ensure that the earlier concepts are embedded before developing further. MWB tasks and questioning can be used to achieve this.

4. **How is your curriculum adapted, designed, or developed to meet the needs of pupils with SEN and disadvantaged pupils**

- Scaffolding is used to support our weaker learners. For example, with graph drawing, the axes with scales are initially provided so students just label the axes and plot simple points. Students will then be given drawn axes and supported in filling in simple scales that go up in 10s. The next step is more complex scales where the learn to calculate the value of 10 squares and the value of one square to plot points. This mirrors what they do in maths. The final step is to draw and plot graphs independently. For some of our students this continues to be a challenge up to Y11
- Scaffolding is also used during questioning to support our weaker learners in thinking through scientific ideas to try and develop a deeper understanding
- Differentiated tasks are built into our schemes of work. However, we are aware that with the changing profile of SEN in the school, these don't always support our weaker learners. Faculty CPD will be used this year to produce resources that can meet this need. This will include modified scaffolded worksheets, modified homeworks, tests and marking grids
- All our SEN students from Y8 to Y11 are included on the intervention regardless of attainment or progress. This ensures they are always a focus
- Seating plans are used alongside the strategy banks to ensure we are consistently employing the specific strategies designed to meet the needs of these students in our class teaching
- There are many opportunities for modelling in science and this supports all students including our SEN students. It is a valuable tool in making the abstract more concrete which can lead to a deeper understanding of science. In practicals for or weaker students, each step is carefully modelled with the students copying each step after the modelling. The use of equipment is still explicitly taught, for example the accurate use of a measuring cylinder. There would be no requirement to do this for more able students at KS4 but our less able and SEN students still require this. Blood through the heart is difficult to visualise – an animation model provides a good opportunity to talk through the flow where it can also be seen.
- Books are marked weekly for SEN students so any misconceptions can be picked up quickly and resolved.
- Staff liaise with LSA support in their classroom to ensure it is used purposefully to support the students in the class.
- Our science technician is always available and on hand to support our SEN students in accessing practical work and ensuring they can complete the practical and obtain a set of reliable results
- Do nows will move to being pure recall of key words for our SEN and low ability students and homework tasks are simplified
- There are students with SEN needs who are not low ability. The strategy banks are used here to ensure they gain the support they need. For example, a visually impaired student needs modified worksheets and resources emailing so she can access these on her ipad. She also needs modification for questions involving graphs. Her need is not due to learning difficulties and staff are aware of how to meet the needs of these students in their groups.
- Often our disadvantaged students lack the cultural capital that many other young people of their age have and take for granted. We need to be aware and take steps to close this gap. For example, when teaching the Ecology units in Y7 and Y10, students have a limited knowledge of the natural world and plants and animals within this. When the topic is taught every time a plant or an animal is mentioned there are pictures so they can visualize what it is and what it looks like. The same is done when referencing habitats.
- At KS3 we plan to run trips to The Centre for Life in Newcastle for Y8, and to Grassington for field work in Y7. The aim here is to take all our students including our disadvantaged students beyond Bradford to broaden their cultural capital and complete fieldwork and visit a high quality science museum. The

current cost of living crisis makes this difficult to provide currently as we would need to ask our families to pay
- At KS4 students are asked to pay for revision guides. However the faculty pays for the guides for our disadvantaged students
- All seating plans are highlighted with our disadvantaged students so they can be targeted for questioning and additional support
- A science club, deadly 60 club and natural science club are all delivered through enrichment within the faculty. This supports developing the cultural capital of our students
- Solutions for the Planet is delivered yearly. This high quality programme has seen three teams reach the regional finals in the last two years.

5. **What is the powerful knowledge in your subject?**

- The nature of science and the content we deliver makes all science powerful knowledge
- In a TES article, Mark Enser points to Alaric Maude who identifies a range of different powerful capabilities suggested by Michael Young that identifies how the powerful knowledge can be used. These link to the first section of this document where we address how our curriculum supports students to have sufficient knowledge and skills for future employment. The powerful knowledge we deliver helps them:
    - Discover new ways of thinking.
    - Better explain and understand the natural and social worlds.
    - Think about alternative futures and what we could do to influence them.
    - Have some power over our own knowledge.
    - Be able to engage in current debates of significance.
    - Go beyond the limits of their personal experience.

- To have a deep understanding of the substantive/powerful knowledge in science, disciplinary knowledge is required. Our science curriculum in both KS3 and KS4 has the disciplinary knowledge mapped out so students actively develop the practical skills required to make sense of the content

Curriculum Implementation

1. **How do you develop the subject knowledge of your staff in your faculty?**

- In science, all staff teach Biology, Chemistry and Physics so it is important that subject knowledge in all three subjects is secure in all staff to give the best possible outcomes for the students
- Faculty CPD has included sessions on teaching energy at KS3 and KS4, carrying out, analysing and evaluating required practicals in all three disciplines, identifying and planning to address common misconceptions, consistency of approach when teaching calculations.
- Trust wide CPD has delivered training on misconceptions in the teaching of osmosis at KS4
- One member of the team attended the five-day STEM course on Physics for non-specialists and a second member of the team has attended to IOP Subject Knowledge for Physics Teaching (SKPT) course. Both these have been used to support the development of physics teaching within the department and also trust wide
- Coaching within the department supports the pedagogy of science teaching in the department. Coaching has been used to develop questioning techniques, scaffolding resources for SEN students, sequencing of teaching a concept to lead to a deeper understanding, the use of resources to support modelling

- Line management meetings have a focus on key students and how staff can be developed and supported to provide what these students need. Students underperforming are identified and a discussion on strategies and resources and signposting teachers to relevant material is the focus for the meeting
- A. number of staff are active Twitter users which provides a wealth of ideas and resources that can be used. Staff share these within the team as they arise
- The ECT framework has developed the pedagogy of members of the team through reading

2. How do you ensure students remember long term the content they have been taught and integrate new knowledge into larger concepts

- Retrieval practice forms the 'Do now' for all lessons in KS3 . Questions are taken from previous units to ensure that taught content is constantly revisited. In KS3 the do now activities are grouped in a block of five with the first two in the sequence pure recall, the second two activities to link key words together through sentences including given words, giving questions that would produce the key word answer provided or grouping words together with reasons why. The fifth is a longer response answer to support the development of extended answer questions.
- KS3 homeworks are all recall based. Each week students are given 25 questions and answers to learn and these are paper based. In morning meeting, they have deliberate practice of the look cover write and check model. The first five questions on the list are recall from previous units with the remaining questions linked to the current unit. Each week, ten questions are chosen from the list and these are competed as an extended do now. Students must achieve 8 marks to pass. If they don't pass but can produce evidence of three rounds of the look cover write check method then they are not issued a detention.
- Our SEND students have a simpler 8 recall questions to learn and they are tested on all 8 questions. These are one word answers and
- In KS4 all classes are set weekly recall homework practice. All students are issued with retrieval practice booklets with the GCSE content for each unit presented as a list of questions and answers. Sets 1 and 2 are given 30 questions and answers to learn a week and sets 3 and 4 have 20 questions to learn a week. These are all from previously taught units so they are practicing retrieving content previously taught. The do nows for the week provide practice on the questions that will be tested and each week a set of 10 questions are selected from those learned and the students need to achieve 8 marks to pass. Again, If they don't pass but can produce evidence of three rounds of the look cover write check method then they are not issued a detention.

- Mind maps are included in all Y7 booklets and this will roll out to Y8 and then into KS4. Students are directed to complete these as a review of learning at key points in the unit. They are encouraged to make links between the ideas learned so they can develop their schema which in term supports recall. Faculty CPD on mind maps and how to build them effectively will be a focus this year.
- The revision lessons written for all units in Y7 will be rolled out into Y8 and then into KS4. These follow a sequence supported by cognitive science research where students go through the following sequence
    - Brain dump which is then used alongside the mind map and KO to see what content is not remembers
    - Flashcards / quiz questions for knowledge not remembered to embed recall
    - Ten definitions of key words or concepts – identify the one that is correct and re-write the ones that are incorrect. Focusses on correcting misconceptions
    - Elaborate on a key sentence or phrase using what, where, how, why to understand the limit of knowledge
    - Sentences combining key words from the topic – differentiated to increase the difficulty for more able students

- MY GCSE is used with Y11. Sets one and two. Cornell note taking is taught and required for each video following a timetable set. MCQs at the end of the video are used to monitor knowledge acquisition. Students are expected to achieve green and are sanctioned if this is not achieved. They are given a week and it is expected that the standard will be reached
- Seneca is used to support revision with Y11 set 3 and 4. The questions are more recall to support the learning of key facts
- Sequencing of the curriculum and revisiting is key in integrating new concepts into larger concepts. This is explained in section two of the curriculum intent part of this document
- This year will see the implementation of a science faculty padlet

3. How do you assess in your subject? Are there any limitations?

- Assessment is a continual process in science lessons
- The MWB provide opportunities every lesson to assess what has been learned and understood. Reteaching can occur if large gaps are identified across the class or 1:1 support can be put in place for the odd students who do not grasp the concepts
- Questioning is used as an assessment tool. Students can be pushed to explain their thinking or give reasons for their thinking in a way that helps the teacher assess the level of understanding achieved. The limitation is it gives you the snapshot for the students questioned, not the class as a whole
- We have end of unit assessments for all our topics with marking grids where students complete tasks to close gaps. The KS4 unit tests come from exampro. Increasingly we are seeing these as not fit for purpose as they do not cover the whole topic and do not follow the format of exams they will get in their GCSE. These will be re written with a foundation and higher paper using past questions that give a representative spread of the topic. Marking grid will have a precise focus on how to close a specific gap with the need to complete a similar calculation, draw a conclusion from a new set of data, or balance an equation rather than answer several lengthy questions.
- Cycle assessments twice a year provide a summative view of our students. The limitations here in Y10 and Y11 is the access our students have to the past exam papers. It is evident that students learn mark schemes making our data unreliable and making it difficult to truly identify gaps and support reducing these gaps. The faculty has offered to support the trust creating exam papers and changing questions to make it harder to rely on a markscheme. All papers created within the faculty will have questions changed

4. What materials and resources do you use to deliver your curriculum? How does this support with teacher workload

- As a science team, all members of the faculty play a role in planning our booklets and centralized schemes of work. The allocation given reflects the hours worked and responsibility in the department with the head of faculty and principal teachers taking on slightly more.
- Y7 booklets, powerpoints and schemes of work for the whole year will be completed by 30 September
- Y8 planning allocation for 2023-24 has already been given.
- Staff are provided with a criteria to follow for all booklets in the faculty and all booklets are quality assured against these criteria. To support workload, the Head of Faulty sourced booklets written by others that are freely available online and created folders so these can be easily accessed. Whilst they cannot be used in their entirety, they are a useful source of activities and content to support our development
- KS4 is delivered through schemes of work written by the faculty and support by schemes of work written by the TCCT.

- We have high quality technician support. All practical requests are met and practical support is provided during by the technician when capacity allows. Recent funding has allowed us to expand our equipment giving greater access to practical work to support learning and avoids the need for teachers to replan as limited resources are being used by another member of staff.
- All students at KS4 have a revision guide and there are also textbooks at KS3 and KS4. At KS3 these are primarily used for high quality cover work and makes it easier for staff with both planned and unplanned absences. The same is also true for the textbooks at KS4 but these are also used to support curriculum delivery as they contain high quality content and questions.
- MyGCSE and Seneca is used to support revision (see curriculum implementation section 2)
- You tube, Free science lessons, Oak academy are examples of many resources that teachers signpost to their students to support delivery of content
- Online homework platforms (Carousel) are used to support with retrieval and spaced practice for homework. This saves time for setting, monitoring and marking homework. The data analysis features also enable teachers to identify whole class misconceptions efficiently and improve the quality of the feedback from homework. The question banks are distributed among the team to support workload

5. How do you develop fluency in reading for your subject? How do you ensure teachers are responsible for disciplinary literacy?

- The Y7 booklets have glossaries of key words and the this will roll into Y8 next year
- Across all year groups new vocabulary is explicitly taught with an acknowledgement that they can often learn more new vocabulary in one science lesson than they do in one Spanish lesson. New words are broken down and the derivation of the different parts of words explained – they often link to latin or Greek words. Another strategy is to ask 'what other words do we know that start with…' 'What do these other words mean?'
- Breaking down exam questions with a focus on the command words and what is expected by each type of word
- Building up fluency of written responses in extended answer questions so they link ideas together coherently.
- Students are expected to answer science questions in full sentences and also write answers in their books in full sentences
- The stories that we have started in Y7 provided an extended piece of reading to support fluency in reading. These draw from scientific discoveries around the topic and allow students to see how ideas have developed over time and the relevance of the content to be delivered to their everyday lives
- There are extended pieces of reading, for example in the Y7 energy booklet where the reading is supported by directed tasks. They are asked to underline key pieces of information in different colours to support students in using the content to answer questions