# Curriculum: PGCE Science (Biology) (11-16) with QTS\*

# AY 21/22



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The PGCE Science ITE Curriculum is underpinned by the Core Content Framework and the FoE Pillars. The Pillars are reflected in the three academic modules ensuring a depth of scholarly analysis to the study of science ITE.

The course commences with students engaging critically with the nature of science knowledge. This enables students to begin to identify with their subject and to defend a philosophical stance for the inclusion of science in the secondary school curriculum. Students debate the historically contested aims and purposes of science education (OFSTED, 2021) in the context of science as a core curriculum subject. This school curriculum context foreshadows the students’ upcoming professional placement. Students critically explore the tensions behind the science curriculum with a focus on the ‘Science for All’ arguments. This approach reflects the *Ambition for All* agenda espoused by OFSTED (2021). Importantly this raises questions around social justice and access for all children to a high-quality science education. Students then critically engage with the content, forms and sequencing of knowledge in the KS3/KS4 Science National Curriculum. This aligns with the assertion that ‘you cannot do science without knowledge… knowledge is an important step in progression to more complex understanding’ (Holman, 2018:24). This includes debates around certain forms of science knowledge and how a high-quality science curriculum carefully sequences the interplay between substantive and disciplinary knowledge (OFSTED, 2021). Students can then critically analyse curriculum knowledge and see how the nature of science (Working Scientifically) plays a fundamental role in curriculum sequencing. Students begin to link conceptual and procedural science knowledge to substantive and disciplinary science knowledge as recommended by OFSTED (2021). Students then critically engage with current debates and pedagogies in science education. These include: the ‘Big Ideas’ agenda, children’s common misconceptions, questioning, practical work, numeracy and inclusion. These issues have been addressed by OFSTED (2021) as key indicators of a high-quality science education This enables students to further develop their philosophy and knowledge of how science curriculum should be organised, how it can be learned in the classroom, barriers to learning science and how policy impacts on science education. Historical curriculum comparisons are then made to illustrate the political motivations and ideologies that influence curricula. This enables students to critically engage with education policy and heighten their political consciousness. Students then critically explore how science knowledge is sequenced and developed through the key stages. This enables them to critique how science knowledge develops as children mature and links to cognitive load theory. Students then critically engage with issues of cross curricular links. This enables them to develop a broader perspective on science and links to subjects such as maths and english.

Early in the course students critically engage with the student’s science teacher identity and related educational philosophies. This early point in the course will raise their identity consciousness and hopefully minimise the risk of them leaving teaching (Hammerness, 2008; Heikonen et al., 2017) A historical critique of education policy then enables the student to see their subject in a wider context of policy and ideological struggle. Again, raising their consciousness of how historical policies have shaped their attitudes towards education. Professional behaviours, safeguarding, well-being and laboratory safety are introduced before the student starts their first placement. Equality, diversity and inclusion issues such as gender, EAL and FBV are then addressed. These are salient in science education due to the dominant historical narrative of scientists as white western men. These issues become increasingly pertinent as the student increasingly analyses and engages with the science curriculum on placement. Later after some initial experience on placement the student investigates their identity as a potential researcher. Now more knowledgeable and experienced on placement this warrants a timely focus on their future professional and academic development.

Students develop on earlier work on the curriculum and how pupils learn science. Key learning theories are then analysed so that students begin to construct their understanding of how children can learn science. These theories enable students to develop coherent links between science specific content earlier in the course. Then students can connect science pedagogical approaches with the content of the science curriculum. At this point students practice and apply their knowledge of science pedagogy in terms of lesson planning, assessment and adaptive teaching. Students learn that effective assessment is particularly relevant in science due to the prevalence of science misconceptions held by children (OFSTED, 2021). The concept of cognitive load theory is critically analysed especially in a science learning context. Drawing on their earlier study students now learn how to plan learning episodes in preparation for the first placement. As the student builds knowledge on placement they will consolidate earlier themes and analyse areas such as questioning, pupil talk, feedback, relationships, behaviour management. Weekly tasks during placement ensure that the student is engaging academically with their increasingly wider experiences and deeper knowledge on placement.

HAMMERNESS, K., 2008. ‘If You Don't Know Where You Are Going, Any Path Will Do’: The Role of Teachers' Visions in Teachers' Career Paths. *The New Educator*, 4(1), pp. 1

HEIKONEN, L., PIETARINEN, J., PYHÄLTÖ, K., TOOM, A. and SOINI, T., 2017. Early career teachers' sense of professional agency in the classroom: associations with turnover intentions and perceived inadequacy in teacher-student interaction. *Asia-Pacific Journal of Teacher Education*, 45(3), pp. 250-266.

HOLMAN, J., 2018. *Improving Secondary Science- Guidance Report*. Educational Endowment Foundation.

OFSTED, 2021. *Research Review Series: science*.GOV.UK [online]. Available from:

<https://www.gov.uk/government/publications/research-review-series-science> [Accessed 23 Nov 2021].

|  |  | Trainees should… | * Prior to PP | * End of Introductory PP | * End of Developmental PP | * Interim on Consolidation PP | * End of Consolidation/Course |
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| PILLAR 1 | Personal & Professional values, attitudes and beliefs | *Learn that:* | * Science teachers possess strong beliefs and deeply value their subject. This enables them to encourage all pupils to perceive science as a curiosity driven subject that relates directly to natural phenomena around them. * Teachers have a legal responsibility and duty of care to keep children safe. All teachers are responsible for safeguarding regardless of their subject area. * Social justice is integral to a publicly democratic education service. Teachers should be politically conscious of how ideologies influence education policy makers. * Teachers should strive to ensure that science education is accessible to all children. | * The teaching profession demands high standards of conduct and behaviour. These include communicating with all colleagues in a respectful and dignified manner and not undermining FBV. * A sensible balance between work and life is essential to ensure the wellbeing and safety of all teachers. * Being reflective is a basic requirement of being a professional. | * Research informed science teaching contributes to effective practice. * Science teachers have a key role in generating educational knowledge. | * Science teachers should actively contribute to the wider life of the school. This can include working with the maths department to develop numeracy strategies in science learning. | * Science teachers continually engage with CPD through the various professional science associations such as the Association for Science Education (ASE), the Royal Society of Chemistry (RSC), the Institute of Physics (IOP) and STEM Learning. |
| *Learn how to:* | * Be alert, recognise and report safeguarding concerns. * Promote and justify the status of science within the secondary curriculum as a core subject. * Conduct themselves as professionals both within their subject and in the wider school context. * Critique policy to recognise and challenge ideologies which threaten social justice. * Audit their personal science subject knowledge and construct an action place to address any areas for development. | * Manage their time effectively and adhere to all school professional expectations. * Reflect on their teaching to evaluate and set targets for development. | * Manage their time effectively to cope with workload * Test and evaluate contemporary approaches in their practice and try out new approaches. | * Communicate effectively with parents and colleagues e.g. SENCO to promote the wellbeing of pupils. * Reflect and evaluate on progress and strategically identify next steps foe development. | * Set targets and identify next steps for the ETC/career development. Engage with support from the ASE, RSC, IOP and STEM Learning * Become actively involved with science communities and events via the ASE, RSC, IOP and STEM Learning |
| PILLAR 2 (Subject & Curriculum knowledge) | How learning occurs & progression | *Learn that:* | * Every child brings to science lessons their own unique understanding and set of ideas of scientific phenomena. These often include misconceptions that do not align with scientific explanations * Children initially draw on this prior knowledge to make sense of the science topics presented by the teacher. This knowledge must be recognised and valued by the science teacher. * Taking children’s prior knowledge into account is key for successful science learning * An important factor in learning is memory and it can be overloaded. * Models and analogies are key strategies in learning science due to the abstract nature of science concepts. * Numeracy plays an important role in many aspects of science learning. * Practical Work forms an important part of science education, but its effectiveness is contested. * To make progress in science there should be an interplay of substantive and disciplinary knowledge. | * Planning science lessons involves using a learning cycle to ensure that progression happens and the learning episode is coherent. * Using literacy and numeracy in learning can contribute positively to engaging pupils into science. | * Prior learning should be reviewed regularly to support the build-up of complex science conceptual understanding. * A strong science curriculum offered the opportunity for new knowledge to become part of an emerging conceptual structure which deepened over time. | * Effective pupil talk can support the exchange of science ideas and reformulate their existing science ideas. | * Supporting pupils in thinking about their own learning (metacognition) increases pupil ownership of learning so they can evaluate the most effective ways of developing their understanding of science concepts. |
| *Learn how to:* | * Elicit children’s existing science ideas through questioning and dialogue. * Plan for effective numeracy activities in science lessons. * Critique the effectiveness of practical work in science learning and ensure that it is purposeful and relevant. * Model processes for scientific problem solving. | * Plan and teach a coherent lesson that builds on pupils’ prior science understanding, offers opportunities for pupils to make progress and assesses learning. * Plan to use literacy and numeracy activities to develop science understanding. | * Plan and teach a carefully sequenced science curriculum where the careful interplay of science substantive knowledge and science disciplinary knowledge allows the children to systematically integrate new knowledge into pre-existing knowledge. This allows pupils to operate at a more scientific abstract level. * Engage with school science schemes of learning to plan a coherent sequence of lessons. | * Design group work to ensure that scientific understanding is further develop and science misconceptions are challenged by peers. | * Actively contribute to science curriculum design in school and in the community e.g. via STEM centres. |
| Curriculum & subject knowledge | *Learn that:* | * The science national curriculum is contested in terms of its aims and purposes. * The ‘Science for All’ debate raises social justice questions. * The 14 ‘Big Ideas’ principles have shaped and influenced the nature of science curriculum. * Working Scientifically is a key aspect of the curriculum which reflects the nature, processes and methods of science. * Science knowledge can be classified as conceptual or procedural. Also known as substantive knowledge and disciplinary knowledge. | * Collaborating with colleagues can promote to the effective use of shared resources. | * Teachers who continue developing their science subject knowledge impact positively on pupil learning, motivation and offer alternative learning approaches. | * Secure science subject knowledge impacts positively on teaching a gradual build of science conceptual understanding. | * Planning for science subject knowledge development throughout their career is professional expectation of all science teachers. This can be supported by woirkshops via ASE, RSC, IOP and STEM Learning. |
| *Learn how to:* | * Audit their science subject knowledge in all three disciplines up to GCSE. Construct an action plan to address areas for development. * Recognise conceptual (substantive) and procedural (disciplinary) knowledge * Utilise narrative stories based on the ‘Big Ideas’ to make science learning coherent and relevant. | * Identify essential concepts, knowledge and skills within a coherent curriculum. * Be alert to science misconceptions and plan to address them. | * Assess science including some GCSE levels and develop knowledge outside their science specialism. | * Become more actively engaged in the construction of coherent medium-term planning. | * Enhance their science and pedagogical knowledge to prepare for teaching outside their science specialism and across the key stages. |
| PILLAR 3 (The craft of teaching & pedagogy) | Assessment | *Learn that:* | * Assessment of learning is an essential component in teaching and learning science. It allows for the checking of children’s understanding to identify gaps and science misconceptions, and how these can be addressed. * Assessment is used to prevent pupils from forgetting what they have learned. | * In lesson planning assessment activities should be directly linked to learning outcomes and assess scientific understanding. * Questioning is an effective strategy to elicit children’s science misconceptions, knowledge gaps and assess their understanding. | * Subject-specific feedback to pupil responses supports learning and checks for science understanding. | * The effective use of pupil data is essential to planning science lessons. * Effective subject- specific feedback can be verbal as well as written. | * Effective marking and subject- specific feedback supports pupils science learning and their ownership of learning. |
| *Learn how to* | * Integrate assessment activities into lesson plans to inform future teaching and support intervention for science misconceptions. | * Plan assessment tasks to check for prior knowledge, gaps and potential misconceptions. * Plan questions which effectively assess learning. | * Provide specific and supportive feedback. * Use purposeful and structured self and peer assessment. | * Offer accurate assessment to pupils to enable them to make the next steps in learning. This should be done in line with school/science department policy. | * Mark formatively and summatively to offer high quality feedback. |
| Adaptive Teaching | *Learn that:* | * Inclusion in science education based on SEND, gender and SES continues to be a relevant issue. * Due to its wide range of learning approaches science is uniquely positioned to provide many learning opportunities for SEND pupils. | * Adaptive teaching means providing opportunities for all pupils to be challenged and stretched rather than planning different tasks. Challenge can be through an amended scientific task which encourages deeper thinking or reasoning that draws on embedded scientific concepts. | * Breaking down complex scientific processes is required for some pupils. * A variety of teaching approaches is required to enable accurate scientific understanding. | * Retrieval tasks can offer a good level of support especially for challenging scientific concepts. | * Teaching to small groups and supporting individual needs is more effective than different lessons to different groups. |
| *Learn how to* | * Provide support for pupils understanding via practical demonstrations, modelling calculations, group investigations and role play. * Use ICT simulations to model complex scientific processes such as the respiratory system, electrical circuits and atomic structure. | * Plan a variety of tasks for pupils to challenge their existing ideas and support the understanding of challenging scientific concepts. | * Support pupils with a range of educational needs such as numeracy anxiety in scientific calculations. | * Construct questions which enable pupils to recall scientific ideas which link to the current topic being taught. For example, atomic structure and electrical current. | * Communicate effectively with TAs to support pupil learning. Involve TAs with planning to ensure pupil needs are met. Communicate complex scientific concepts to TAs. |
| Behaviour | *Learn that:* | * Attitudes to science will impact on pupil behaviour. * Behaviour management in science is impacted by the nature of the subject. For example, practical lab learning requires a particular approach to managing behaviour. * Effective behaviour management is based on positive relationships focused on mutual respect and dignity. | * Planning for a positive learning environment and stressing the relevance of science to the pupils’ everyday lives can create positive behaviour in all pupils. * Relationships are key to securing a positive learning environment. | * Encouraging a sense of curiosity can motivate pupils to articulate their own opinion and engage in dialogue on science topics. | * Having a confident and responsive attitude to pupil behaviour enables pupils to make progress and minimises interruptions to learning. | * A whole school approach to behaviour management is critical to the school ethos. The roles of the senior team and form tutors are crucial. |
| *Learn how to:* | * Set high expectations linked to pupil outcomes by designing challenging and engaging science learning activities. * Start a lesson with an engaging science activity using courteous language and positive body language. | * Organise and manage a whole class science practical session to ensure good behaviour. * Build positive and professional relationships with pupils. * Follow and apply the school policy in terms of rules, sanctions and rewards. | * Plan learning opportunities for pupils to discuss their ideas and opinions in an environment of trust. * Provide clear and specific instructions for activities. In science this is particularly relevant for practical work. | * React decisively to behaviour management in the classroom and engage with parents to manage and support pupil behaviour. | * Critically reflect on different approaches to behaviour management in their school placement setting. |
| SFE PRIORITIES AY 21/22 | English as an Additional Language (EAL) | *Learn that:* | * Jim Cummins framework is essential for pupils with EAL esp. with a focus on context embedded, cognitively demanding. * CALP and BIC skills are important for language acquisition and teachers need to plan for them. * That it is important to include context embedded and cognitively demanding work for all pupils but especially those with EAL. | * That it is important to address misconceptions, such as learners with EAL have an additional need not a special need. * EAL learners are not a homogenous group. * How context embedded and cognitively demanding is simply good teaching and useful for all learners; for example, by providing translation word cards for key science vocabulary. | * The Jim Cummins Iceberg model – that language 1 and language 2 are interdependent. * That children with EAL need extra support with colliquations, vocabulary depth and vocabulary breadth and so the teacher needs to consider this at the planning stage. * There are stages of progression to language development and relate to Hilary Hester’s BEL stages. * Group work and discussion is essential for language acquisition in all subject disciplines and learners with EAL may require support in using specific language to demonstrate scientific understanding. | * There are various approaches within science that support all children with context embedded and cognitively demanding work. * Instructions for science practical work will require greater support and strategies such as picture cards and instructional non-verbal videos. * It is important to understand how to manage children’s behaviour and recognise whether the behaviour is related to feelings of isolation and/or language barriers. | * Pupils with EAL may have additional barriers to their learning such as experiences of being a refugee or external pressures such as the need to be the translator for their family. * It is important to use the BEL stages for assessment but that there are other models. * The importance of avoiding cultural appropriation. |
| *Learn how to* | * Adapt teaching to include dual language cards or text to support language acquisition in science. * Identify key vocabulary that will be needed in the science learning and understanding. | * Ask the teacher questions about their practice. * To ask questions about the rationale for grouping children with EAL esp. if they observe a pupil with EAL in a lower competency group. * Adapt their teaching and standard schemes of work so that they can offer scientific explanations embedded and cognitively demanding activities that support language acquisition. | * Use dual language books, flashcards, and visual aids to support reading comprehension to access scientific vocabulary and explanations. * Evaluate resources and activities related to science that may be suitable for pupils with EAL including visits to museums, science centres and outdoor learning spaces. * Recognise the 4 BEL stages of development and identify some of the approaches that may be suitable for specific stages of language acquisition. | * Use the BEL stages for assessment * How to celebrate culture, languages and difference in all classes and throughout a school. * Be sympathetic to the needs of pupils with EAL and those who are refugees. * Address ways of supporting families who have EAL. | * Assess the stage of language development through assessment stages and consider support strategies * Evaluate (and if necessary, challenge) any poor EAL practices in school. |
| Relationship & Sex Education (RSE) | *Learn that:* | * The goals/aims for RSE are very different to the aims or goals of other curriculum subjects and these should be recognised and foregrounded when teaching it. * There are 4 core areas to the statutory secondary RSE curriculum: Identity, gender and sexuality, Consent and healthy relationships, Anatomy, sexual health and fertility, and RSE in a digital context. * Ground rules in RSE teaching are important. | * In the RSE classroom, consciously ensuring pupil safety is paramount given the often-sensitive nature of the subject matter and the goals of the curriculum. * Awareness and the use of language in RSE is important e.g., heteronormative, cis-normative etc. * The RSE classroom is not the place to debate their morality but to provide non-judgemental information about how to access services etc. | * SRE should Provide information which is realistic and relevant, and which reinforces positive social norms. * Lessons should start where students are: find out what they already know, understand, are able to do and are able to say. | * Importance of avoiding making any assumptions about pupils, taking a measured, rather than value-laden approach. * RSE dovetails with foundational knowledge for understanding other compulsory topics such as fertility, sexual health, FGM and menstruation (which is technically part of health education). | * RSE includes planning to teach explicit life skills (e.g., planning, decision-making skills), specific skills (e.g., communication, sexual negotiation skills) and promote resilience. * Distancing techniques which will enable learners to depersonalise the topic being discussed, should be incorporated. |
| *Learn how to* | * Reflect what the new guidance means for their own teaching practice. * Appreciate the role, purpose and value of RSE in the curriculum. * Create a classroom environment which encourages explorative learning, questioning and development while ensuring safety. | * Gently challenge misconceptions and misuse of language which emerge. * Model acceptance and celebration of differences in sexual orientation, sex preference and decisions (while always championing consensual relationships). | * Ensure that any bi/homophobia, bullying, offensive language is challenged in the classroom, whatever the basis of the viewpoint. * Take a positive approach which does not attempt to induce shock or guilt but focuses on what students can do to keep themselves and others healthy and safe and to have positive, healthy relationships. | * Respond to challenges that they might encounter in the RSE classroom. * Avoid pedagogy that may be misleading and contribute to shame and stigma. * Apply a wide variety of approaches to teaching and learning, with an emphasis on interactive learning and the teacher as facilitator. | * Ensure that students are informed, empowered and safe as they develop and grow through secondary school and beyond. * Develop strategies and resources for teaching RSE, relating specifically to Identity, gender and sexuality, Consent and healthy relationships, Anatomy, sexual health, and fertility, and RSE in a digital context. |
| Safeguarding & digital wellbeing | *Learn that:* | * Safeguarding and Digital Wellbeing is an essential part of ITE and looking after pupils, colleagues and themselves. Inclusive of their conduct when learning and teaching online. * All professionals have a responsibility and duty of care for the pupils, colleagues and themselves in relation to the Recognise, Respond and Report (3R’s) * Keeping Children Safe in Education (2021) and Working together to safeguard children (2018) are of fundamental importance and a valuable source of guidance for all educational professionals. * Settings have their own Safeguarding Policies which must be followed by all in that setting. * Every setting should have a Designated Safeguarding Lead (DSL) who is the first point of contact for any safeguarding concerns.   Safeguarding pupils involves not promising confidentiality, sharing pertinent information and reassuring the pupil of their disclosure. | * Every setting has their own safeguarding policy and all professionals in that setting should uphold its content and ethos. * Pupils are not a homogenous group and therefore support for safeguarding needs to be individualised whilst also still following all safeguarding procedures * Peer on Peer abuse and sexual harassment are current priorities for all settings. * The following are requirements to know and implement as a teacher: * 1) they are essential part of the safeguarding system for children. * 2) To identify concerns early, provide help, promote welfare and prevent concerns from escalating. * 3) Providing a safe learning environment for all pupils and young adults. * 4) Be prepared to identify children / young adults who may benefit from early help * 5) Safeguard children’s and young people wellbeing and maintain public trust in the teaching profession as part of their professional duties | * Safeguarding relies on a wider network of support and intelligence sharing, such as across a school or LEA setting. * Bullying, including Cyberbulling is wrong and can take many forms. * Safeguarding involves promoting the welfare of children and colleagues within the school and wider community. | * The adverse experiences of pupils can have an affect upon learning and progress * The wider impact of safeguarding of pupils, vulnerable young people in relation is linked to Child Criminal Exploitation (CCE) and Child Sexual Exploitation (CSE).   A high quality RSE curriculum can assist n safeguarding pupils by embedding knowledge and understanding and empowering teachers to provide/recognise safeguarding concerns. | * Safeguarding is everyone’s responsibility and that a child centred approach will ensure this is as essential. * Consistent awareness and professional development will ensure the protection and care in a proactive way for all pupils, colleague and themselves.   . |
| *Learn how to:* | * Undertake an Audit of safeguarding knowledge and understanding underpinned by KCSIE (2021) online resource to identify their readiness for professional practice. * Engage with further CPD development undertaken through Prevent training (Government link) * Identify the signs of possible abuse * Report disclosures to the necessary DSL including the DSL at Edge Hill * Keep themselves safe online and in settings by, for example, ensuring they do not promise confidentiality, only share information with key staff (e.g. DSL), and not prompting the pupil during their disclosure. | * Confidently and competently report safeguarding concerns in their setting and at University. * Conduct themselves in a professional and safe manner in educational Setting. * Respond to a pupil’s disclosure and act immediately adhering to the necessary steps.eg. recognising signs of abuse / knowing what County lines involves and the impact on the school / community. * Implement procedures and processes in line with an educational setting including reporting incidents/concerns to the DSL | * Identify how a safe and secure environment is established for pupils. * Identify the importance and essential approach to ensuring the welfare of pupils both in school and their community. * Seek advice and guidance for professional colleges on sensitive issues regarding welfare and safeguarding eg. Inclusive of FGM and Prevent and other essential areas of safeguarding. | * Identify symptoms and situations related to safeguarding within a school and wider context. Supporting and reinforcing focus from the RSE curriculum involving essential topics such ‘Sexual Harassment’ and ‘Peer on Peer Abuse in school’ * Recognise the impact of Adverse childhood experiences and different forms this can take upon their learning and education. | * Become a confident and competent advocate regarding safeguarding and digital wellbeing within a school and wider context. * Identity when to act upon situations and the professional manner this must uphold. * Undertake further professional awareness and understanding through continual updates provided by the DfE, Designated Safeguarding Lead (setting they are employed in), NSPCC updates and policy guidance aligned to DfE. |