**Primary Initial Teacher Education: Curriculum Plan**

**Science: Undergraduate Programmes**

School based training **Golden nuggets**

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| **Curriculum Intent:** Our intention is to instil the following into every Edge Hill University graduate teacher:1. *To have a passion for teaching science.*
2. *To have secure science subject knowledge so that they can teach across the primary age range with confidence.*
3. *To have a secure understanding of primary science pedagogy, and for practical, first-hand experience to be the predominant approach they use in their own classrooms.*
4. *To be a curious, life-long learner.*
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| **Phase** | **Learn that…** | **Learn how to…** |
| **Phase 1 (Y1)** | **Trainees will know:**  | **Trainees will be able to:**  |
| * That the science national curriculum provides a programme of study for the knowledge (physics, chemistry and biology) and skills (working scientifically) which children learn aged 5-11 and that the spiral structure provides a minimum requirement and enables progression of substantive and disciplinary knowledge **LT3.1**
 | * **Use the national curriculum to identify composite outcomes and consider how to break this down into component steps LH3.1,**
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| * **Consider the order in which components of substantive and disciplinary knowledge are taught in science in order to sequence learning effectively within a lesson** with tutor and peer support. **LH2.1, LH2.3,**
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| * **The key findings from the OFSTED Research Review Series: Science (2021) LT8.2**
 | * **perform the 6 types of enquiry (Observation, pattern seeking, sorting and classifying, fair testing and secondary sources). LT3.2**
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| * **That expertise in science is built through developing two forms of knowledge: Substantive and Disciplinary**
 | * use a planning board to carry out a fair test. **LT3.2**
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| * **Use their understanding of the key findings from the OFSTED Research Review Series: Science when considering their planning and teaching. LT8.2**
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| * That disciplinary knowledge involves knowledge of methods scientists use to answer questions, Knowledge of apparatus and techniques, data analysis and knowledge of how science uses evidence to develop explanations **LT3.2**
 | * **Support children to understand complex concepts by using concrete materials and progress to pictorial and abstract representations with increasing familiarity and confidence. LH4.6**
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| * That disciplinary knowledge needs to be taught explicitly rather than absorbed through practice and needs to be revisited. **LT3.5, LT3.6**
 | * **identify a range of suitable approaches to elicit children’s ideas**
* **address misconceptions through planning and teaching**
* **use concept cartoons to promote conceptual change.**
* **address misconceptions through planning and teaching. LT2.2, LT2.6**
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| * **The 6 types of enquiry - observation over time; pattern seeking; identifying, sorting and classifying; comparative and fair testing, research using secondary sources and problem solving.LT 3.2**
 | * plan a short teaching sequence to include teacher subject knowledge, resources, key vocabulary and assessment with peer and tutor support **LH2.1**
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| * **That secure teacher subject knowledge is essential to high quality teaching and learning in science LT3.2**
 | * recognise high quality science teaching through virtual observation with tutor support and/or through observation of mentor and / science subject leader where this fits with the schools planned curriculum. **LH2.1, LH2.2, LH2.3,**
 |
| * the subject knowledge required to teach the following with confidence: materials (key stage 1); rocks, fossils and soils; sound and plants **LT3.2**
 | * **Plan and teach a well sequenced science lesson which considers substantive and disciplinary knowledge with mentor support initially where this fits with the schools planned curriculum. LH2.1, LH2.2, LH2.3, LH3, LH 4.2, LH4.3 LH4.6**
	+ Or plan a well sequenced lesson for an alternative class within the school-based training
	+ Or work with mentor/ science subject leader within a tutorial to discuss examples plans and evidence of pupil work linked a science lesson that has been delivered and discuss the processes that made this effective for all learners.
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| * **How complex concepts can be explained using concrete initially moving to pictorial and abstract with increasing familiarity and confidence LT4.4, LH4.6**
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| * how to select and use resources to teach the following topics effectively: materials (key stage 1); rocks, fossils and soils; sound and plants **LT4.2**
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| * **That engaging children in their science learning is important but learning activities are carefully selected in order to also develop deep understanding of the associated concepts LT3.6**
 | * experience and explain the rationale behind the Bucket School approach to teaching LOtC **LT1.1**
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| * Within the context of science - the key principles of planning for learning and teaching and the importance of careful sequencing of components of learning to facilitate progress towards composite outcome. **LH2.1, LH2.3, LT 4.2**
 | * use resources in an effective sequence to explore activities to teach: materials in KS1, rocks and fossils, sound and plants **LT4.2**
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| * **That in high quality science curriculums knowledge is carefully sequenced to build on prior learning and reveal the interplay between substantive and disciplinary knowledge. LT4.4**
 | * use technology to measure something quantitatively (e.g. sound in decibels) and recognise that this moves children’s learning on from qualitative description (e.g. the drum is louder than the shaker) **LT 3.2**
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| * Considering cognitive load in science. How to break down complex ideas into smaller component parts in order to reduce risk of cognitive overload. **LT2.4, LT2.7**
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| * Strategies to support pupils to make connections between schema in science.
* That knowledge of the curriculum is essential to plan for these connections within and between both topics and year groups **LT3.7, LT3.8**
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| * The different ways to organise the classroom (including behaviour management) to ensure pupils learn safely and make good progress **LT7.1, LT7.2**
 |
| * Behaviour management in practical science lessons. Pace, use and positioning of resources, routines and roles **LT 7.1, LT7.2**
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| * **a range formative strategies to assess learning in science LT 6.1, LT6.3**
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| * **about the lives of a diverse range of scientists including female scientists (Mary Anning), scientists of colour (Katherine Johnson), those with disabilities (Stephen Hawking) and the impact they have had on our everyday lives**
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| **Trainees will understand:**  |
| * That working scientifically is embedded within the NC and should be taught through the substantive content
* That disciplinary knowledge must be sequenced and connected with substantive content that most appropriate to teach and develop this knowledge.
* That there are 6 types of enquiry scientists use to answer questions and the importance of developing confidence in all of these approaches **LT3.2**
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| * The implications of the key findings within the OFSTED Research Review Series: Science, on their own practice. **LT8.2**
 |
| * that disciplinary knowledge needs to be taught in sequence and through substantive content that is carefully selected to best illustrate it.
* there is an order of progression in graphing data
* how using quantitative measurements enables children to present data in graphs
* that 2 sets of numerical data must be gathered in order for children to present their data in a line graph and that this is needed for children to make progress in upper key stage 2 **LT3.2**
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| * **The importance of secure subject, pedagogical and curriculum knowledge as a primary science teacher and it’s role in planning for effective science learning LT3.2**
* how to plan a science lesson for effective learning to take place
* how learning theory applies to practice and influences how we teach the way in which we teach (including constructivism, schema, working memory and cognitive load) **LT3.7**
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| * **That science is being ‘squeezed out’ of the curriculum and the implications of this on future learning (state of the nation report 2020) LT8.2**
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| * **How to support children to learn conceptual knowledge including first-hand practical experiences and alternative approaches to use when this is not possible.**
* **that models and analogies are effective ways of teaching concepts which are hard to see or tricky LT4.3**
 |
| * that misconceptions are children’s ideas which are based on their experience. **LT2.2, LT2.6**
 |
| * what learning outside the classroom (LOtC) is and why it is important **LT3.2**
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| * **health and safety considerations related to the activities they carry out**
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| * What high quality science teaching looks like through observation of mentor and / science subject leader where possible during school-based training and/or through virtual observation with tutor support. **LT4.2**
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|  | **Composite knowledge / understanding / skills***By the end of this phase trainees will* ***know:**** That high-quality teaching and learning in science requires strong teacher subject, pedagogical and disciplinary knowledge

*By the end of this phase trainees will* ***understand:**** that substantive and disciplinary knowledge in science should be taught simultaneously and supported with first-hand practical experiences wherever possible.

*By the end of this phase trainees will* ***be able to:***Plan and teach a science lesson that is appropriate to the needs of the learners, that draws on children’s prior learning to develop subject knowledge and enquiry skills and provides opportunities to assess the learning that has taken place.  | **Assessment pertaining to phase 1*** Assessment will take the form of a confidence audit at the start of the phase and a computer marked assessment at the end of the taught element to assess what has been learned through centre-based training. A written submission will evaluate a science plan drawing on research to justify the science specific pedagogical decisions made within the planning process.
* Assessed during PP1
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| **Research, literature and resources supporting the curriculum design of Phase 1.** | * **Primary Science Knowledge & Understanding, Peacock, Sharp, Johnsey, Write and Sewell, 2021.**
* **Primary Science Theory & Practice, Sharp, Peacock, Johnsey, Simon, Smith, Cross and Harris, 2021.**
* **Research Review: Science, Ofsted, 2021**
* **The Teaching of Science in Primary Schools, Harlen and Qualter, 2017.**
* **Maintaining Curiosity, Ofsted 2013**
* **ASE: Guide to Primary Science, Serret and Earle. 2018**
* **ASE materials**
* **STEM learning centre materials**
* **National Curriculum, 2014**
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| **Phase 2** | **Trainees will know:**  | **Trainees will be able to:** |
| * the **subject knowledge** required to teach the following with confidence: classifying living things; how living things adapt; evolution; how living things move; digestion; circulatory system; grouping materials and particle theory; forces (including magnets, gravity, air and water resistance and friction). **(LT3.2)**
 | * Select appropriate disciplinary knowledge to be taught through substantive content. **(LH3.1, LH3.4)**
* **To sequence components of substantive and disciplinary knowledge within a lesson and across a series of lessons in a way that supports progression in children’s learning** with peer and tutor support initially. **(LH2.3, LH2.4)**
 |
| * practical strategies for teaching and learning science using interesting and stimulating context in areas including: classifying living things; how living things adapt; evolution; how living things move; digestion; circulatory system; grouping materials and particle theory; forces (including magnets, gravity, air and water resistance and friction). (**LT4.3)**
 | * use resources to explore activities to teach: classifying living things; how living things adapt; evolution; how living things move; digestion; circulatory system; grouping materials and particle theory; forces (including magnets, gravity, air and water resistance and friction). **(LH3.6)**
 |
| * how to choose and use resources to teach the following topics effectively: classifying living things; how living things adapt; evolution; how living things move; digestion; circulatory system; grouping materials and particle theory; forces (including magnets, gravity, air and water resistance and friction). **LT4.2**
 | * use models and analogies as a theoretical approach to tackle more abstract concepts **(LH3.5, LH)**
* use modelling, guides, scaffolds and worked examples to support learning and embedding new concepts in science and remove these where no longer required **(LH3.13, LH4.2)**
 |
| * investigate opportunities for science learning in other contexts and situations outside of the classroom to provide interesting and stimulating contexts **(LH1.1)**
 |
| * **The importance of sequencing components of substantive and disciplinary knowledge carefully to ensure progression within a lesson and across a sequence of lessons and avoid cognitive overload of working memory (LT2.2, LT2.4)**
 | * use practical scientific methods, processes and skills (i.e. working scientifically) to teach content **(LH3.13)**
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| * how working scientifically underpins the nature, processes and methods of science and is embedded within the content. **(LT3.3)**
 | * **make use of research to make informed decisions about teaching and learning primary science, particularly linked to learning theories (LH5.5)**
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| * **that there are some areas of the national curriculum that may need to be delivered sensitively (and how to do this)**
 | * plan and deliver a workshop with peers to include a set of activities within one topic covering various year groups **(LH4.2, LH4.4, LH4.5, LH4.6)**
 |
| * **the importance of risk assessment and health and safety**
 | * further address misconceptions through the planning of their workshop **(LH3.7)**
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| * the importance of creative approaches when teaching science whilst ensuring concepts are learned and understood **(LT4.4)**
 | * consider the importance of progression of learning for children through the planning of their workshop **(LH4.1, LH2.4)**
 |
| * The importance of using problem solving approaches to engage and motivate children with secure conceptual understanding. (**LT3.6, LT3.7, LT3.8)**
 | * produce a risk assessment in relation to their workshop **(LH8.2)**
 |
| * To apply a wide range of professional studies concepts such as schema, working memory and cognitive load, in the context of science learning effectively. **LT3.7**
 |
| * **that new knowledge in science should be connected with what children have previously learned and pupils should be supported to make connections between different concepts that will support retrieval and application to problem solving. (drawing on their understanding of schemata and working memory) (LT2.2, LT2.7, LT3.7)**
* That retrieval activities and repeated practice can be used in science to embed learning in long term memory **(LT2.8, LT2.9)**
* That hinge questions can be used to inform the direction of science session in response to pupil feedback **(LT6.1, LT6.5)**
* That anticipating misconceptions in science is an important part of curriculum knowledge and that misconceptions can be more likely to develop when progression is too fast and prior learning insecure. **(LT2.6, LT3.4)**
 | * **Plan and teach an effective sequence of science lessons in school which demonstrate a secure application of science specific pedagogies and the integration of substantive and disciplinary knowledge within sessions** with mentor support where appropriate within the schools planned curriculum. **(LH2, 3, and 4)**
	+ Or plan a sequence for an alternative class within the school-based training
	+ Or work with mentor/ science subject leader within a tutorial to discuss examples plans and evidence of pupil work linked to a sequence of science learning that has been delivered and discuss the processes that made this effective for all learners.
 |
| **Trainees will understand:**  |  |
| * the key componentsof an effective science lesson plan and the importance of medium-term plans in sequencing learning effectively over time **(LT3.3, LT3.7)**
* **The importance of linking disciplinary knowledge with the appropriate substantive content in which to teach it and how this will need sequencing and revisiting over a longer period of time (LT3.3, LT3.7)**
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| * **how other adults can support children’s learning effectively in science (LT8.5)**
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| * **how to adapt teaching in science to ensure progress for all including children with SEN/D, EAL and those who require stretch and challenge (LT5.1, LT5.3, LT5.4, LT5.5)**
 |
| * how to nurture, develop and stretch pupils’ talents and interests **(LT5.1, LT5.3)**
 |
| * the importance of risk assessment in relation to their own micro teach workshop
 |
| * how teaching and learning theory underpin their approaches to science
* that modelling helps pupils understand new processes and ideas; good models make abstract ideas concrete and accessible and experience its application to a range of concepts **(LT4.3)**
* That guides, scaffolds and worked examples can help pupils apply new science concepts and can be gradually removed as pupil expertise increases **(LT4.4)**
 |
|  | **Composite knowledge / understanding / skills***By the end of this phase trainees will* ***know:**** key subject knowledge in relation to: classifying living things; how living things adapt; evolution; how living things move; digestion; circulatory system; grouping materials and particle theory; forces (including magnets, gravity, air and water resistance and friction).

*By the end of this phase trainees will* ***understand**** the importance of sequencing science learning and adapting teaching to allow for progression of all learners **(LT2.2, LT2.6, LT3.3, LT5.1)**

*By the end of this phase trainees will* ***be able to:***Plan and teach a series of science lessons that is sequenced to develop subject knowledge and enquiry skills over time **(LH1.1, LH2.1, LH2.2, LH2.3, LH2.4, LH2.8, LH3.7, LH4.1, LH4.2, LH5.5, LH5.6)** | **Assessment pertaining to phase 2**Students will complete short, focussed formative assessment tasks at the end of each taught session. Students will complete a confidence audit towards the end of the module to inform intervention support. Students will complete a computer based test to assess the module content.Students will plan and deliver a micro teach session to their peers and tutors to demonstrate their subject and pedagogical understanding. Within their micro teach students will consider how to sequence the learning into component steps towards a composite outcome. Students will consider cognitive load, adaptive teaching, common misconceptions and reflect carefully on the teaching approach selected and resources used in their session design. Assessed during PP2 |
| **Research, literature and resources supporting the curriculum design of Phase 2** | * **Primary Science Knowledge & Understanding, Peacock, Sharp, Johnsey, Write and Sewell, 2021.**
* **Primary Science Theory & Practice, Sharp, Peacock, Johnsey, Simon, Smith, Cross and Harris, 2021.**
* **Research Review: Science, Ofsted, 2021**
* **The Teaching of Science in Primary Schools, Harlen and Qualter, 2017.**
* **Maintaining Curiosity, Ofsted 2013**
* **State of the nation report of UK primary science education, Wellcome Trust 2017**
* **Primary Science Capital Teaching approach materials, Archer 2021**
* **ASE materials**
* **STEM learning centre materials**
* **National Curriculum, 2014**
 |
| **Phase 3 (Y3)**  | **Trainees will know:**  | **Trainees will be able to:** |
| * the subject knowledge required to teach the more conceptually challenging concepts with confidence: gravity; static electricity, levers, pulleys & gears. **LT3.2**
 | * self-assess and set targets related to subject knowledge and professional practice **LT8.2**
 |
| * **the process of summative assessment in science including end of key stage judgements and the importance of record keeping**. **LT6.1**
 | * experience first-hand how talk can build conceptual knowledge **LT4.7**
 |
| * Use planned talk to support children to share their ideas, progress their scientific vocabulary and develop conceptual understanding. **LT4.7**
 |
| * How science planning at different levels act to ensure coverage and quality of provision **LT4.1, LT4.2,**
 | * identify links between science and PE **LT3.8**
 |
| * Draw on research to develop a range of teaching approaches which can be used to tackle controversial issues **LT8.1**
 | * Support children to select variables when conducting a pattern seeking enquiry. To select appropriate variables depending on the graphing skills they are supporting the children to develop. **LT3.2**
 |
| * **The importance of planning for talk in supporting children to use and apply new vocabulary and share ideas LT4.7**
 | * plan effective teaching activities related to nutrition and microorganisms **LT3.2**
 |
| * How to access ongoing continuous professional development via science specific providers **LT8.1**
 | * **Take ownership of a unit of science planning and demonstrate that they can plan for an effective sequence of sessions which is informed by and adapted in response to assessment of children’s learning in science** where this fits with the planned curriculum in school. **LH2.1, LH2.2, LH2.3, LH2.4, LH2.5, LH2.6 (LH3, 4, 5.2,5.3, 5.5, 5.6, 5.7 and 6.1, 6.3, 6.4, 6.5)**
 |
| * That Covid-19 has impacted upon children’s health and access to practical science and that there are long term implications to consider as a teacher. **LT1.6**
 | * **demonstrate their own curiosity, love of learning and commitment to continuing development of their subject knowledge. LT1.2**
 |
| * Seek out CPD opportunities in their ECT years and beyond using their knowledge of Science specific providers e.g. STEM learning centre and ASE. **LT8.1**
 |
| **Trainees will understand:**  |  |
| * why teaching controversial topics can present a challenge **LT1.1, LT1.5**
 |
| * the current issues related to children’s health as a result of Covid-19 and begin to consider the implications of this for the role of the class teacher **LT1.1, LT1.6**
 |
| * How the Ofsted Inspection Framework influences planning and teaching in England. **LT8.1**
 |
| * **how thematic teaching can engage and motivate children, sparking their curiosity for learning and that is also important to maintain focus on the subject specific learning within this approach. LT3.8**
 |
| * the importance of key vocabulary, use of images, video and first-hand practical experience **LT3.6**
 |
| * how talk enables children to share their ideas, progress their scientific vocabulary and develop conceptual understanding. **LT4.7**
 |
| * **How to sequence science learning considering the application of professional skills components – e.g. planning to avoid cognitive load, interleaving and repeated practice. (LT2.4, LH2.1, LH2.2, LH2.3, LH2.4, LH2.5, LH2.6)**
 |
|  | **Composite knowledge / understanding / skills***By the end of this phase trainees will* ***know:**** *the features of effective teaching and learning in science.*

*By the end of this phase trainees will* ***understand:**** *the bigger picture-issues surrounding primary science education which directly impact on classroom teaching.*

*By the end of this phase trainees will* ***be able to:**** Plan and teach an effective sequence of science learning which is informed by assessment of prior learning, uses science specific pedagogies to *facilitate progression in subject knowledge and enquiry skills, integrates formative assessment and is appropriate to the needs of the learners.*
 | **Assessment pertaining to phase 3*** Students will use their school-based planning and lesson observation feedback as a starting point for reflection target setting facilitated by tutors. Students will complete a computer-based test to assess the module content.

Students will research an issue of their choice from 5 central themes and present as part of a seminar peer discussion drawing on their research and experiences and reflect on implications for their practice. Tutors to assess.Assessed during PP3 |
| **Research, literature and resources supporting the curriculum design of Phase 3** | * **Primary Science Knowledge & Understanding, Peacock, Sharp, Johnsey, Write and Sewell, 2021.**
* **Primary Science Theory & Practice, Sharp, Peacock, Johnsey, Simon, Smith, Cross and Harris, 2021.**
* **Research Review: Science, Ofsted, 2021**
* **The 10 Key Issues with Children’s Learning in Science, Bianchi, Whittaker and Poole,** **2021**
* **Primary Science Journal.**
* **The Teaching of Science in Primary Schools, Harlen and Qualter, 2017.**
* **Misconceptions in Primary Science, Allen, 2017**
* **Maintaining Curiosity, Ofsted 2013**
* **State of the nation report of UK primary science education, Wellcome Trust 2017**
* **Primary Science Capital Teaching approach materials, Archer 2021**
* **ASE materials**
* **STEM learning centre materials**
* **National Curriculum, 2014**
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