**Primary Initial Teacher Education: Curriculum Plan**

**Science: Postgraduate Programmes**

***NB – this curriculum plan identifies when trainees will ‘meet’ content for the first time – the intention is that at each phase, university and school-based colleagues will support trainees in recalling, refining, applying and discussing content from the previous phases.***

**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.*

| **Phase** | **Learn that…** | **Learn how to…** |
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| **Phase 1**  **(University-led)** | **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** | * **Select appropriate disciplinary knowledge to be taught through substantive content. LT3.2, LT3.5, LT3.6** * Perform the 5 types of enquiry (Observation, pattern seeking, sorting and classifying, fair testing and secondary sources). **LT3.2** * Use a planning board to carry out a fair test. **LT3.2, LT4.3** |
| * That expertise in science is built through developing two forms of knowledge:   Substantive - Scientific knowledge and conceptual understanding Disciplinary - Working scientifically. **LT3.2**   * 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** * 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 approaches to elicit children’s ideas. LT2.2** * Use concept cartoons to promote conceptual change.   address misconceptions through planning and teaching. **LT2.2, LT2.6** |
| * Evaluate learning opportunities in terms of impact on substantive and disciplinary knowledge. **LT3.2** * **Identify the risk associated with an investigation and the safety measures to be implemented to ensure a safe learning environment. LH7.1** * Construct a risk assessment for an outdoor science activity. **LH7.1** |
| * **The 5 types of enquiry - observation over time; pattern seeking; identifying, sorting and classifying; comparative and fair testing and research using secondary sources. LT3.2** | * Plan short teaching sequence to include teacher subject knowledge, resources, key vocabulary and assessment with peer/ tutor support. **LH2.1, LH2.3, LT4.2** |
| * **That secure teacher subject knowledge is essential to high quality teaching and learning in science.** **LT3.2** * The subject knowledge required to teach science concepts with confidence including forces, seasonal change, animal classification, food chains, and living things in their environment. **LT3.2** | * To identify important components of learning required within a lesson and sequence these effectively to support pupils to make progress towards composite outcomes in science with peer and tutor support initially. **LH4.1 LT4.2** * Plan an effective science lesson using a range of teaching approaches which encourage children’s curiosity with peer and tutor support. **LH4.1 LT4.2** * Plan opportunities for children to talk in science in order to share ideas and build conceptual knowledge. **LH4.1,** **LT4.7** |
| * **The research that supports learning in science including constructivism, SPACE, AKSIS, OFSTED: Maintaining curiosity and Research Review: Science. LT8.2** * **The different pedagogies used to support learning in science including first-hand experience; modelling; analogies; simulations; role play; multi-sensory approach. LT4.4 LT4.6** |
| * 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, LT4.2** * Understand that 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. **LH2.2, LT4.2** * **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 a variety of formative assessment strategies to assess learning in science. **LT6.4** * Adapt learning and teaching to support children’s individual needs. **LT5.3, LT5.7** |
| * Use resources effectively to explore learning of science concepts in a variety of topics including electricity, evolution and inheritance, digestion; materials and particle theory; forces including air-resistance and friction and relevant science issues. **LT4.2** |
| * 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. **LT4.2** | * Make links between the history and development of science ideas and the scientists who have had a direct impact upon the lives we live today. |
| * The benefits of learning outside the classroom in terms of learning, closing the attainment gap and supporting mental health and the importance of H&S and risk assessment in maintaining a safe learning environment. **LT1.1 LT3.2** |  |
| * Strategies for formative assessment in science. **LT6.4** |
| * The importance of language in conceptual development in science including talk for science and the understanding of scientific vocabulary. **LT4.7** |
| * Adaptive learning approaches to support learning in science including children with SEN and EAL. **LT5.3, LT5.7** |
| * How complex concepts can be explained using concrete initially moving to pictorial and abstract with increasing familiarity and confidence. How this approach will support all children in learning new concepts but in particular those with EAL – The Cummins Quadrat. **LT5.3, LT5.7, LH3.5** |
| **Trainees will understand:** |  |
| * **How research applies to practice and influences how we teach the way in which we teach science (including constructivism, schema, working memory and cognitive load) LT8.2** |
| * That working scientifically is embedded within the NC and should be taught explicitly and alongside the substantive content. **LT3.1** * That disciplinary knowledge must be sequenced and connected with substantive content that most appropriate to teach and develop this knowledge. **LT3.2** |
| * **The importance of secure subject, pedagogical and curriculum knowledge as a primary science teacher and its role in planning for effective science learning. LT3.2** |
| * That misconceptions are children’s ideas which are based on their experience, prior learning and science capital. **LT2.2, LT2.6, LT3.4** |
| * The different pedagogical approaches used to support science learning and how to employ these effectively including: questioning, first-hand practical experiences, models, analogies etc. **LT4.3 LT4.6** * **How talk enables children to share their ideas, progress their scientific vocabulary and develop conceptual understanding. LT4.7** |
| * **The key elements of an effective science lesson plan and how to plan a science lesson for effective learning to take place. LH2.1, LH2.3, LT4.2** |
| * How to use prior learning, resources and scaffolds to support enquiry-based learning effectively. **LT4.2 LT4.3 LT4.4** |
| * Health and safety considerations related to the activities they carry out and the importance of risk assessment, particularly in relation to LOtC. **LT1.1, LT3.2** **LH8.2** |
| * 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** |
|  | **Composite knowledge/understanding/skills**  *By the end of phase 1 trainees will* ***know:***   * key substantive and disciplinary knowledge and pedagogical approaches required to support learning and teaching of science.   *By the end of phase 1 trainees will* ***understand:***   * How learning theory and pedagogical approaches apply to practice and influence how we teach in science and how this is adapted to enable all children to make good progress.   *By the end of phase 1 trainees will* ***be able to:***   * Plan a quality science lesson with support of tutor and peers that integrates working scientifically and considers prior learning, adaptive teaching, subject specific pedagogy and assessment and risk assessment. | **Assessment pertaining to phase 1**  Assessment will take the form of the science audit at the start of the phase. · Assessment in each session through peer discussions, tutor questioning, peer modelling. Common misconceptions are built into each session. The importance of working memory and long term memory are discussed in relation to students own experiences as well as in relation to the pupils they will teach.  Students will complete short, focussed formative assessment tasks at the end of each taught session. Students will complete a computer based test to assess the module content. Which will inform the interventions offered in phase 5. |
| **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** | |
|  | **Trainees will know:** | **Trainees will be able to:** |
| **Phase 2** | * The needs of learners within their school-based placement and how their science teaching could be adapted to ensure the progress of all learners with mentor support initially. **LH5.5, LT4.2, LT5.3** | * **Plan and teach a lesson which considers children’s prior knowledge and supports them to make progress if appropriate within the school’s planned curriculum. LH4.1 LT2.2**   + Or, alternatively, conducted within an alternative class within the placement school   + Or through mentor tutorial see how this has been done effectively at a different point in the academic year. |
| * **The subject knowledge required to make informed decisions about planning teaching and assessing learning in science within the context of their placement. LH3.4, LT3.2, LT3.5, LT3.7** |
|  | **Trainees will understand:** | * Adapt teaching to consider the science needs of leaners with support of the class teacher. **LH5.2, LH5.5, LT5.2, LT5.3** * Or see how science planning has previously been adapted through tutorial with mentor/ science leader. |
| * How substantive and disciplinary knowledge could be incorporated into lesson plans with mentor support. **LH3.3, LH4.1, LT3.2** |
| * How to apply the school behaviour policy to practical science sessions to ensure a safe and purposeful learning environment. **LH7.1** |
| * How to apply the school’s risk assessment and health and safety measures to practical science sessions. **LH7.1** |
|  | **Composite knowledge/understanding/skills**  *By the end of this phase trainees will* ***know:***   * How to plan for the needs of the learners within their school-based placement and the appropriate level of subject knowledge to make informed decisions about planning, teaching and assessing learning for the phase in which they are teaching. (feedback will be provided by class teachers/mentors/link tutors whilst on professional practice)   *By the end of this phase trainees will* ***understand:***   * How to plan for effective learning in science considering behavioural expectations and risk assessments. (feedback will be provided by class teachers/mentors/link tutors whilst on professional practice)   *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 assess the learning that has taken place. Where appropriate within the schools planned curriculum - Or via tutorial discussion with mentor/ science subject leader. | **Assessment pertaining to phase 2**  Assessed throughout Professional Practice 1. Lesson observations, weekly development meetings and weekly focus tasks. |
| **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** * **ASE: Guide to Primary Science, Serret and Earle. 2018** * **ASE materials** * **STEM learning centre materials** * **National Curriculum, 2014** | |
| **Phase 3**  **(University-led)**  *\*Trainees will review the knowledge, understanding and skills developed at Phases 1 and 2, and will add the following…* | **Trainees will know:** | **Trainees will be able to:** |
| * The subject knowledge required to make informed decisions about planning teaching and assessing learning in science at KS1 and KS2. **LT3.2** | * Identify targets regarding personal subject knowledge and make use of research to develop the knowledge and understanding to make informed decisions about learning and teaching in primary science. **LT8.2 LT8.7** |
| * Science specific pedagogical knowledge to enable them to plan teach and assess primary science. **LT3.2, LT4.1, LT4.2** * A range of pedagogical techniques to teach more conceptually challenging topics such as Earth and Space where opportunities for first-hand practical experiences are limited.**LT4.3, LT4.6, LT4.7** | * **Plan a sequence of learning in science using a range of teaching approaches which enable all children to make good progress towards composite substantive and disciplinary outcomes with peer and tutor support initially. LH3.1, LT4.2** |
| * **The importance of developing sessions that consider children’s progression in substantive and disciplinary knowledge. LT4.2** | * **Evaluate learning and teaching of science. LT3.2** |
| * **How to plan for progression in learning in science by considering the order, pace and review of components of substantive or disciplinary knowledge in order to support pupils to reach their composite outcomes. LT4.2** | * **Incorporate formative assessment strategies into science lessons in order to provide effective feedback. LT6.4, LT6.5** |
| * Investigate opportunities for science learning in other contexts and situations outside of the classroom to provide interesting and stimulating contexts that progress learning beyond the NC. **LT1.1** |
| * **The statutory requirements for assessment in science. LT6.1** * **The process of summative assessment in science including end of key stage judgements. LT6.1, LT6.3, LT6.4** |
| * About the lives of a diverse range of scientists including female scientists, scientists of colour (Katherine Johnson – Earth and Space), those with disabilities (Stephen Hawking – Earth and Space) and the impact they have had on our everyday lives. **LT1.2, LT1.6** |
|  |
| * **Trainees will understand:** |
| * How to use research to make informed decisions about learning and teaching in primary science. **LT8.2** |
| * **How to sequence science learning considering the application of professional skills components – e.g. planning to avoid cognitive load, interleaving and repeated practice. LT4.2, LT4.4** |
|  | **Composite knowledge/understanding/skills**  *By the end of this phase trainees will* ***know:***   * How to use assessment techniques in science to inform future planning and the importance of planning for progression in subject knowledge and enquiry skills.   *By the end of this phase trainees will* ***understand:***   * How to sequence learning effectively to facilitate progression in subject knowledge and enquiry skills   *By the end of this phase trainees will be* ***able to:***   * Plan for an effective sequence of science learning with peer and tutor support | **Assessment pertaining to phase 3**  Assessed in final taught session through peer discussions, tutor questioning, peer modelling.  Assessed through peer and tutor discussion following student workshops in final session:  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. |
| **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 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** | |
| **Phase 4**  **(School-led – Professional Practice 2)**  *\*Trainees will observe, discuss, apply and secure the knowledge, understanding and skills developed at Phases 1, 2 and 3, and will add the following…* | **Trainees will know:** | **Trainees will be able to:** |
| * How to use the school’s MTPs and LTPs to plan for an effective sequence science learning via mentor or science subject lead tutorial. **LH2.4, LT4.2, LT4.4** | * Plan and teach an effective sequence of science learning that is adapted to the needs of the learners if appropriate within the school’s planned curriculum. **LH5.5, LT5.3**   + Or, conducted for an alternative class within the placement school   + Or through mentor tutorial see how this has been done effectively at a different point in the academic year. |
| * If appropriate, consider how schemes of work can be adapted to reflect best practice and the needs of learners within their class via mentor or science subject lead tutorial. **LH2.3, LH2.4, LH3.6, LT4.2 LT4.4** |
| * How to sequence components of science learning into a logical order that will support children to reach their composite outcomes across a sequence of lessons for a specific group of learners. **LH2.4, LT4.2, LT4.4, LT4.8** | * Plan and teach a sequence of science lessons that draws on prior learning and uses formative assessment to inform future lessons. **LH2.1, LH2.4, LH3.6, LH4.10, LT4.6**   + Or, conducted for an alternative class within the placement school   + Or through mentor tutorial see how this has been done effectively at a different point in the academic year. |
| * How to use the teacher assessment framework to assess exemplar materials in terms of emerging, expected and exceeded (via university twilight input whilst on placement.) **LT6.1, LT6.3, LT6.4** | * Adapt the direction of a lesson in response to pupil feedback. For example, making use of hinge questions. **LH6.1, LH6.4, LT4.6** |
| * How to adapt teaching for the science needs of the learners within their setting. **LT5.3, LT5.7** | * Use the teacher assessment framework to assess exemplar materials in terms of emerging, expected and exceeded. **LT6.1, LT6.3, LT6.4** |
| **Trainees will understand:** |  |
| * How to sequence science learning in a specific context considering planning to avoid cognitive load, interleaving and repeated practice. **LT2.4, LT2.7, LT3.7** |
| * The importance of considering the teaching order of components within a sequence of learning and how this links with supporting children to develop their knowledge and understanding within a specific context. **LT4.2, LT4.4** |
|  | **Composite knowledge/understanding/skills**  *By the end of this phase trainees will* ***know:***   * How to use a school’s long term and medium-term plans and schemes of work as a starting point to sequence learning. *(Feedback will be given by class teacher/mentor/link tutor during professional practice)*   *By the end of this phase trainees will* ***understand:***   * The importance of carefully sequencing learning to best facilitate transferal to long term memory. *(Feedback will be given by class teacher/mentor/link tutor regarding applying theory to practice when planning for learning in a logical order during professional practice)*     *By the end of this phase trainees will be* ***able to:***   * Plan and teach an effective sequence of science learning which uses science specific pedagogies to facilitate progression in subject knowledge and enquiry skills and integrates formative assessment. *(Feedback will be given by class teacher/mentor during professional practice)* | **Assessment pertaining to phase 4**  Assessed throughout Professional Practice 2. Lesson observations, weekly development meetings and weekly focus tasks. |
| **Research, literature and resources supporting the curriculum design of Phase 4** | * **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** | |
| **Phase 5**  **(University-led)**  *\*Trainees will review the knowledge, understanding and skills developed at Phases 1, 2, 3 and 4, and will add the following…* | **Trainees will know:** | **Trainees will be able to:** |
| There is no specific whole cohort delivery of curriculum science for Phase 5.  There are opportunities for personal development through independent CPD and intervention opportunities for those who identify that they would benefit. | |
| * **That secure teacher subject knowledge is essential to high quality teaching and learning in science.** **LT3.2** * The subject knowledge required to teach science concepts with confidence including conceptual development in physics, chemistry and biology. **LT3.2** * How to promote an enthusiasm for science and engage children in their learning | * To identify important components of learning required within a lesson and sequence these effectively to support pupils to make progress towards composite outcomes in science. **LH4.1 LT4.2** * Plan effective science lessons using a range of teaching approaches which encourage children’s curiosity. **LH4.1 LT4.2** * To keep in touch with developments in science through engagement with science associations such as the STEM learning centre and ASE. |
| **Trainees will understand:** |  |
| * **The importance of secure subject, pedagogical and curriculum knowledge as a primary science teacher and its role in planning for effective science learning. LT3.2** * How the Ofsted Inspection Framework influences planning and teaching in Science. |
| **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 importance of science as a core subject and the opportunities it affords pupils to address issue of social justice.  By the end of this phase trainees will be able to: ·  Plan and teach an effective sequence of learning in science, which is informed by assessment of prior learning, uses specific science pedagogies to facilitate progression in subject knowledge, integrates formative assessment and is appropriate to the needs of the learners. LT3.5, LH3.3, LH4.1, LT6.1, LT6.3, LT6.4 |
| **Research, literature and resources supporting the curriculum design of Phase 4** | * **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** * **State of the nation report of UK primary science education, Wellcome Trust 2017** | |