Sciences Collaboration Group Event 28.11.24

Event summary

Education Scotland hosted its Sciences Curriculum Improvement Cycle Collaboration Group event on Thursday 28 November 2024 in Glasgow. The purpose of the event was to begin the process of reviewing Scotland's science curriculum. On the day, 77% of the 118 participants were practitioners, drawn from different education sectors and representing 31 of the 32 local authorities in Scotland. They were joined by science and STEM partner organisations and took part four workshop sessions which are described below.

Session 1 (click here for session 1 analysis)	**What's working /what's not working within the existing curriculum?** Participants were provided with a summary of eight key findings from the pilot curriculum reviews. After reading the summary, they were asked to consider three questions: 1. Do these findings reflect your experiences teaching science within CfE? Is there anything missing? 2. Which three findings would you identify as top priorities? 3. What aspects of the science curriculum are working well and should be kept? Participants responded individually on their own section of the placemat, before summarising group views in the middle.
Session 2 (click here for session 2 analysis)	**Science and the four capacities** Participants were asked to reflect upon the four capacities and to reflect on examples of where the **current** science curriculum supports them. Groups were then asked to collate their responses and align them to one of the four capacities, leaving anything in the centre that they felt did not align (would be identified as what was missing). Participants were then asked to reflect on the summary of the Sciences Principle and Practice paper and align items raised within this document to each of the four capacities.
Session 3 (click here for session 3 analysis)	**What does a future-oriented sciences curriculum look like?** Participants were first asked to imagine what a world in 2037 would look like. They were then asked what they felt learners would need in the future. These ideas were then prioritised into critical (maximum of four ideas), very important (maximum of four ideas) and important (as many ideas as they liked).
Session 4 (click here for session 4 analysis)	**Sharing and discussion within sector groups** Participants had an opportunity to meet with others in the same sector to discuss the key messages for the core group, and their key takeaways for sharing within their own networks.

Original images of the output from these activities can be found on the event Padlet: Sciences Curriculum Improvement Cycle (CIC) Collaboration Group 28.11.24 (padlet.com). The output from the day has also been typed up and is available to review on the Padlet.

Analysis of output from Session 1
What's working/what's not working within the existing curriculum?

Summary of responses to Q1

- **Need for clarity and coherence**: There is a significant lack of clarity in essential knowledge and skills across the curriculum, leading to inconsistencies in how the Experiences and Outcomes (Es&Os) are interpreted by different schools and local authorities. A streamlined approach to knowledge and skills is necessary for better progression and assessment in science education.
- **Focus on core content**: Educators emphasise the need to declutter the curriculum by reducing excessive content and focusing on core scientific principles. This would help in building a solid foundation for students and facilitate better transitions from primary to secondary education.
- **Integration of skills and knowledge**: There is a call for better integration of skills and knowledge within the curriculum, as the current separation leads to confusion and a lack of coherence in teaching practices. A skills-based approach is recommended to enhance learning outcomes.
- **Support for early learning and childcare and STEM opportunities**: Early years education needs more support in STEM areas, and there is a need for a more equitable distribution of resources and opportunities across different educational sectors.
- **Addressing gender disparities in STEM**: The findings highlight the importance of addressing the under-representation of girls in STEM fields, particularly at higher levels of education. Strategies to build confidence and awareness of diversity and inclusion in STEM are necessary.
- **Practical skills and real-world connections**: There is a need for more emphasis on practical skills and real-world applications of science, including connections to industry and career opportunities. This would help students understand the relevance of their learning.
- **Challenges in assessment and progression**: Issues related to assessment, moderation, and progression through different educational phases are prevalent. There is a need for clearer guidelines and support materials to aid teachers in navigating these challenges.

Overall, the findings reflect a consensus among educators on the need for a more coherent, integrated, and supportive science curriculum that addresses current challenges and prepares students for future opportunities.

Summary of responses to Q2

This was completed by totalling how many participants prioritised each of the eight findings presented in the summary of the pilot reviews. The top three priorities are below.

1. **Curriculum simplification (58.8%)**
   Participants highlighted the need to declutter the curriculum and reduce content to allow for deeper learning.
2. **Clarification of essential knowledge (51.8%)**
   There is a strong demand for clearly defining the essential knowledge that learners need to progress. This includes a focus on the four capacities of education and addressing the barriers posed by the current technical framework.
3. **Challenges in transitioning (48.2%)**
   The report identifies significant challenges faced by learners during transitions, particularly from primary to secondary and the disconnect between the Broad General Education (BGE) and the Senior Phase. Participants noted that inconsistencies in knowledge and skills among educators can lead to gaps in student learning, resulting in some students repeating content unnecessarily.

It should, however, be noted that all eight findings were prioritised by multiple participants, and many felt that they were interlinked.

Summary of responses to Q3

- **Employer engagement**: There is a growing recognition of the need for collaboration between schools and employers to better prepare students for future roles in industry. Employers can play a significant role in bridging the gap between education and the workforce.
- **Curriculum depth and challenge**: The science curriculum is perceived as not sufficiently challenging for the most able students, as indicated by PISA data. There is a call to maintain depth in certain areas while ensuring that inquiry and investigative skills are prioritised throughout the educational journey.
- **Practical work and resources**: Practical, hands-on learning opportunities are essential and should be preserved despite budget constraints. There is a need for support networks and resources to facilitate effective practical work in science education.
- **Integration of skills**: The curriculum should focus on embedding 21st-century skills, such as creativity, collaboration, and critical thinking, alongside traditional science content. This includes making learning relevant to real-world contexts and ensuring that students are engaged and curious.
- **Flexibility and autonomy**: There is a strong emphasis on the need for flexibility in the curriculum to allow for individual school contexts and the expertise of practitioners. This flexibility can enhance the integration of interdisciplinary learning (IDL) and make science education more relevant.
- **Professional development**: There is an appetite for continuous professional learning and upskilling in STEM for educators, which is crucial for maintaining high-quality teaching and fostering student engagement.

- **Student engagement**: Learners show a strong interest in science, particularly when it is taught through inquiry-based and experiential learning approaches. Engaging with industry and real-life applications of science helps students see its relevance in everyday life.
- **Curriculum review and improvement**: While the current curriculum has strengths, there is a consensus that it requires ongoing revision and updating to ensure it meets the needs of students and prepares them effectively for future challenges.

Overall, the findings highlight the importance of a dynamic, engaging, and relevant science curriculum that prepares students for the future while fostering a love for learning and inquiry.

Summary of findings by sector

For interest, participants were asked to indicate which sector they represented, to allow the identification of any differences between sector groupings. The findings below used the same methodologies as described above, but considering only the responses of those who identified as belonging to each key sector in turn. The number of responses is given in brackets below the sector name. Some participants did not note their sector and so their responses are not included in the summary overleaf. Where participants indicated they represented multiple sectors, their response has been recorded in multiple sections.

Sector	Question 1 Practitioners across all sectors broadly agreed that the findings represented their own experience. Below is a summary of points participants felt were missing:	Question 2 The findings prioritised by most participants in each sector are listed below:	Question 3 Key themes highlighted as strengths by each sector are summarised below:
ELC (14)	• Specialist Input and training • Curriculum and framework issues • Lack of focus on STEM in early years • Staff confidence and resources	• Curriculum simplification (64.3%) • Clarification of essential knowledge (42.9%) • Challenges with Experiences and Outcomes (42.9%)	• STEM initiatives and funding • Curriculum flexibility • Teaching critical thinking and inquiry • The role of play and curiosity • Cross-curricular pedagogy
ASN (4)	• Lack of progression for ASN learner • Relevance and accessibility for learners with complex needs • Challenges in the senior phase • Lack of expertise in ASN teaching for science qualifications	• Challenges in transitioning (75%) • Curriculum simplification (50%) • Integration of cross curricular knowledge (50%) • Challenges with Experiences and Outcomes (50%)	• Autonomy, choice, and flexibility • Collaboration and sharing across schools • Learning for Sustainability
Primary (28)	• Teacher confidence and training • Focus on skills-based learning • Resources and support	• Curriculum simplification (60.7%) • Clarification of essential knowledge (60.7%) • Challenges with Experiences and Outcomes (50%)	• STEM challenges, competitions, and engagement • Integration with technology and real-life contexts • Curriculum flexibility and integration with other areas • Skills-based learning and scientific thinking • Support networks and professional development

Sector	Question 1 Practitioners across all sectors broadly agreed that the findings represented their own experience. Below is a summary of points participants felt were missing:	Question 2 The findings prioritised by most participants in each sector are listed below:	Question 3 Key themes highlighted as strengths by each sector are summarised below:
Secondary (45)	• Separation of knowledge and skills • Lack of resources	• Curriculum simplification (57.8%) • Challenges in transitioning (55.6%) • Clarification of essential knowledge (51.1%) • Clarity on progression (51.1%)	• Flexibility and autonomy • Skills development • Practical work • Opportunities for IDL and collaboration • Content relevance
Partners (23)	• Gender representation and diversity in STEM • Industry connections and career opportunities • Curriculum flexibility and relevance • Practical learning and inquiry-based approaches	• Integration of cross-curricular knowledge (65.2%) • Curriculum simplification (47.8%) • Clarification of essential knowledge (47.8%)	• Importance of experiential learning and industry connections Flexibility and integration in science education • Focus on practical work and skills development • Focus on environmental and climate change education • Outdoor learning

Analysis of output from Session 2 - Science and the four capacities

Summary of each capacity

Please note there will be crossover between capacities. Feedback from participants was that it was challenging to align examples to one single capacity and therefore depending on the discussions at individual group level, aspects of the current science curriculum may appear in different capacities.

Successful learner

Key themes and common threads on successful learners in the current science curriculum.

1. **Engaging and practical learning experiences**
   - **Hands-on and practical work**: Practical activities, experiments, and inquiry-based learning are widely highlighted as effective strategies for fostering engagement and deeper understanding.
   - **Real-world applications**: Linking science concepts to real-life problems and contexts encourages relevance and motivation.
   - **Independent and collaborative learning**: Opportunities for both independent research and teamwork, including group discussions and collaborative experiments, promote skills development.

2. **Building core skills**
   - **Critical thinking and reasoned evaluations**: Emphasis on developing the ability to analyse, evaluate, and draw conclusions from data and experiments.
   - **Transferable skills**: Key skills like creativity, problem-solving, curiosity, initiative, communication, literacy, numeracy, and ICT are prioritised across activities.
   - **Scientific method and skills development**: Focusing on hypothesis formation, experimentation, and evaluation is central to building scientific literacy and competency.

3. **Curriculum and assessment alignment**
   - **Four capacities of CfE**: Success is measured through fostering "successful learners," but there is concern about balancing this with "confident individuals," "effective contributors," and "responsible citizens."
   - **Assessment diversity**: Varied assessment approaches, including AVUs, LO1s, assignments (Senior Phase), presentations, and self/peer assessment, provide multiple ways for students to demonstrate learning.
   - **Focus on exam success**: A tension exists between depth of knowledge (senior phase) and breadth (BGE), with an exam-focused approach sometimes narrowing skill development.

4. **Enthusiasm and motivation**
- **Curiosity and wonder**: Encouraging curiosity leads to deeper engagement and knowledge retention.

- **Teacher enthusiasm**: The role of passionate, encouraging teachers is key in inspiring students.
- **Play and inquiry in early years**: Open-ended, curiosity-driven, and play-based approaches in ELC nurture a natural enthusiasm for learning.

5. **Integration across disciplines**
   - **Interdisciplinary learning (IDL)**: Science as a context for applying literacy, numeracy, and other skills. Projects, sustainability themes, and local/global issues promote connections across subjects.
   - **Technology and innovation**: Use of digital tools (e.g., data loggers, multimedia presentations) enhances engagement and understanding.

6. **Diversity and equity in pathways**
   - **Inclusive opportunities**: Providing alternative pathways (e.g., NPAs, vocational links, and non-formal qualifications) ensures accessibility for all learners.
   - **STEM and DYW links**: Collaboration with external partners, universities, and STEM ambassadors opens diverse career pathways and positive destinations.

7. **Learner-centred approaches**
   - **Pupil voice**: Encouraging students to co-create learning experiences and shape their curriculum through interests and feedback.
   - **Personalised success**: Tailoring learning experiences to ensure every student experiences success and achieves their potential.

8. **Challenges and areas for improvement**
   - **Curriculum gaps in BGE**: Concerns about an overly content-heavy focus in BGE reducing opportunities for skill-building and creativity.
   - **Equity across capacities**: The current focus on "successful learners" may overshadow the development of other capacities.

Summary of focus areas for successful learning in science

- Active, hands-on, and contextualised learning.
- Core skills development, particularly critical thinking, literacy, and numeracy.
- Ensuring balance between curriculum breadth and depth.
- Leveraging curiosity and motivation through engaging content and pedagogies.
- Promoting inclusivity and diverse pathways for all learners.
- Strengthening IDL and STEM connections for real-world relevance.
- Enhancing assessment practices to capture varied dimensions of success.

Effective contributor

Key themes on effective contributors from collaboration group responses

The responses highlighted several recurring themes about fostering **effective contributors** in learners through the current science curriculum.

1. Teamwork and collaboration

- **Group work**: Practical tasks and science investigations commonly involve group work, encouraging students to communicate, collaborate, and share ideas.
- **Team-building skills**: Activities like jigsaw tasks, STEM clubs, and competitions foster collaboration and collective problem-solving.
- **Partnerships**: Opportunities to work with peers, staff, and external partners (e.g., STEM Ambassadors, universities) enhance team collaboration.

2. Problem-solving and resilience

- **Critical thinking**: Encouraged through problem-solving activities and applying knowledge in new contexts (e.g., real-world scenarios, experimental evaluations).
- **Resilience**: Experiments and projects teach students to cope with setbacks and adapt when outcomes differ from expectations.
- **Open-ended inquiry**: Tasks that involve designing solutions, conducting research, or working within constraints (e.g., budgets) develop creativity and resilience.

3. Leadership and initiative

- **Leadership opportunities**: Students lead initiatives like Young STEM Leader (YSL) programs, presenting findings, teaching younger pupils, or organising events (e.g., John Muir Award, assemblies).
- **Student-led learning**: Pupils take initiative in planning and executing investigations or projects, such as creating models or designing solutions to real-world problems.

4. Communication and expression

- **Presenting ideas**: Verbal and written communication is developed through presentations, reports, and discussions.
- **Sharing knowledge**: Pupils explain findings to diverse audiences (e.g., parents, peers) and participate in public speaking or multimedia presentations.
- **Scientific discussion**: Opportunities to debate topical issues or explore the ethical and societal implications of scientific developments.

5. Real-world context and application

- **Connecting learning to society**: Topics such as renewable energy, environmental challenges, and scientific careers emphasise science's relevance to modern life and industry.
- **Project-based learning (PBL)**: Real-world scenarios (e.g., designing sustainable distilleries or satellite dishes) encourage practical applications of knowledge and skills.

6. Extra-curricular and cross-curricular engagement

- **Clubs and competitions**: Activities such as science clubs, STEM challenges, and robotics provide practical, hands-on learning beyond the classroom.
- **Cross-curricular integration**: Science often intersects with other areas, such as numeracy (calculating budgets or analysing data), literacy (writing reports), and interdisciplinary projects (e.g., sustainability themes).

7. Diverse pathways for engagement

- **Inclusive participation**: Activities are tailored to allow all learners, including ASN (Additional Support Needs) students, to contribute meaningfully.
- **Child-led planning**: Particularly in early years (ELC), child-led exploration and play-based approaches enable contributions in ways suited to individual abilities and interests.

8. Skills development and progression

- **Incremental skill building**: Opportunities for problem-solving and critical thinking grow more sophisticated from BGE (Broad General Education) to senior phase courses.
- **Meta skills**: Developing "soft skills" like adaptability, curiosity, and collaboration is embedded in inquiry and project-based tasks.
- **STEM pathways**: Exposure to STEM careers and innovative projects motivates engagement and practical contributions.

Summary of focus areas for effective contributors:
Science education fosters **effective contributors** by embedding teamwork, problem-solving, leadership, and communication skills within collaborative, real-world contexts. Extracurricular and cross-curricular activities enhance engagement, while the flexibility to adapt tasks ensures accessibility and relevance for all learners.

Responsible citizen

Key themes on responsible citizens from teacher responses

The responses highlight the ways the current science curriculum fosters **responsible citizenship**, emphasising ethical awareness, sustainability, and informed decision-making.

1. Topical science and ethical debates

- **Topical issues**: Using current, real-world issues such as climate change, AI, stem cells, and renewable energy to engage learners.
- **Ethical debates**: Discussions on complex topics like genetic testing, vaccination, and environmental impact help students form informed ethical views.
- **Personalisation and choice**: Students choose topics of interest (e.g., research tasks, Newsround discussions) to deepen engagement.

2. Sustainability and environmental awareness

- **Understanding impact**: Focus on humanity’s effect on the planet, including climate change, habitat destruction, and pollution.

- **Sustainability education**: Practical activities like litter picks, recycling, and energy conservation projects emphasise responsible behaviour.
- **Outdoor learning**: Activities like gardening, allotments, and eco-clubs build respect for and connection to the environment.

3. Science literacy and informed decision-making

- **Evaluating issues**: Students critically analyse environmental, scientific, and technological issues, fostering the ability to make informed choices.
- **Data interpretation**: Developing scientific literacy through analysing real-world data related to environmental challenges.
- **Global citizenship**: Encourages awareness of local and global contexts, focusing on Scotland's role in STEM and sustainability.

4. Community and action-oriented learning

- **Place-based learning**: Linking science learning to the local community and environment through projects like clean beaches, allotments, or climate campaigns.
- **Action projects**: Initiatives like COP26 involvement, robotics projects linked to SDGs, and eco-school activities provide hands-on contributions to sustainability goals.
- **Cross-curricular activities**: Partnerships between science, technology, social studies, and local organisations for broader impact.

5. Critical and reflective thinking

- **Ethical views**: Encouraging students to think critically about controversial issues and form their own perspectives.
- **Future impact**: Helping students understand their role in shaping a sustainable future and their capacity to make meaningful contributions.
- **Reflection on rights and responsibilities**: Promotes understanding of personal and societal responsibilities, rights, and obligations.

6. Extracurricular engagement

- **Clubs and competitions**: Eco-clubs, STEM clubs, and initiatives like the COP message-in-a-bottle project allow for deeper exploration of responsible citizenship.
- **Leadership roles**: Opportunities for students to lead sustainability efforts, such as eco-schools, fundraising, and advocacy campaigns.

7. Curriculum integration and opportunities

- **Learning for Sustainability (LfS)**: Embedding sustainability and global citizenship themes across topics and phases.
- **Barriers to consistency**: Some teachers note variability in explicitly connecting science to responsible citizenship themes across the curriculum.
- **Project-based learning**: Using interdisciplinary approaches to tackle real-world problems with practical, impactful solutions.

Summary of focus areas for responsible citizens:

Science education builds **responsible citizens** by engaging learners in ethical debates, fostering sustainability awareness, and connecting learning to community and global contexts. Practical projects, critical thinking, and topical science discussions empower students to understand and address complex challenges. However, there is a call for more explicit and consistent integration of these themes across all stages of education.

Confident individual

Key themes on confident individuals from teacher responses

The responses highlight how the current science curriculum builds **confidence** through hands-on learning, risk management, and collaborative experiences.

1. Risk management and resilience

- **Assessing risk**: Practical activities and experiments develop the ability to assess risks and make informed decisions (e.g., lab safety, outdoor learning, cooking, electricity).
- **Building resilience**: Learning from failures (e.g., unsuccessful experiments) helps students adapt and persevere, fostering resilience.
- **Real-world relevance**: Applying risk assessment skills to real-life problems builds confidence in managing personal safety and decision-making.

2. Practical and experiential learning

- **Hands-on activities**: Engagement in practical work (e.g., building circuits, gardening, outdoor tasks) develops independence and confidence in problem-solving.
- **Freedom to explore**: Providing opportunities for open-ended, child-led exploration, especially in early years and primary settings.
- **Tinkering and problem solving**: Encouraging experimentation and discovery builds self-assurance in learners' abilities to handle challenges.

3. Collaborative and leadership opportunities

- **Group work**: Collaborative tasks allow students to relate to others, develop teamwork skills, and build confidence through shared successes.
- **Leadership roles**: Opportunities to lead learning experiences (e.g., Young STEM Leader Programme, peer coaching, assemblies) help develop leadership and communication skills.
- **Communication skills**: Presenting findings, sharing views, and participating in discussions enhance confidence in expressing ideas.

4. Celebrating success

- **Recognition and achievement**: Awards and programmes like CREST, YSLP, and competitions (e.g., F1 in Schools, lab tech challenges) boost motivation and self-esteem.
- **Positive feedback**: Constructive feedback and encouragement during tasks build confidence and reinforce a growth mindset.

5. Health and wellbeing awareness

- **Healthy lifestyles**: Science topics like biology, body systems, and environmental health connect with promoting physical and mental well-being.

- **Active learning**: Links with physical activities (e.g., outdoor education, sports clubs) emphasise healthy choices and active living.

6. Scientific literacy and critical thinking

- **Making informed choices**: Developing scientific literacy helps students evaluate risks, consider consequences, and make reasoned decisions in everyday life.
- **Debate and Reasoning**: Opportunities for open discussions on ethical and scientific issues (e.g., climate change, smoking, vaping) build confidence in articulating views.

7. Outdoor and community-based learning

- **Engaging with nature**: Outdoor activities like gardening, residential trips, and local projects (e.g., Pallet Garden) foster confidence in unfamiliar environments.
- **Community connection**: Initiatives involving local contexts (e.g., clean-ups, recycling programmes) allow students to engage meaningfully with their surroundings.

8. Creativity and curiosity

- **Encouraging wonder**: Inquiry-based learning, open questioning, and fostering curiosity enhance confidence by allowing students to explore their interests.
- **Scientific exploration**: Activities that inspire awe, like learning about the natural world or experimenting with materials, nurture a sense of capability and curiosity.

9. Building science capital

- **STEM careers and role models**: Exposure to STEM pathways through ambassadors, competitions, and real-world examples connects learning to future opportunities.
- **Contextual learning**: Relating science to everyday experiences and interdisciplinary connections (e.g., aerodynamics in F1, food science) builds confidence in applying knowledge.

Summary of focus areas for confident individuals:
Science education empowers **confident individuals** by offering practical experiences, fostering collaboration, and celebrating achievements. Through risk assessment, resilience-building, and opportunities for leadership and exploration, students develop the skills and mindset to thrive. These elements are reinforced by health and well-being topics, creative problem-solving, and meaningful community engagement.

Key themes on what is missing in the curriculum

The teacher responses identify gaps in the curriculum and areas for improvement to better align with the four capacities of the CfE.

1. Scientific literacy and critical thinking

- **Critical thinking**: Developing the ability to evaluate sources, analyse data, and identify misinformation (e.g., "fake news").
- **Topical science**: Stronger links to real-world issues like climate change, health, and technology to make learning relevant and impactful.

- **Ethical decision-making**: Teaching informed, ethical views on science-related issues (e.g., sustainability, environmental responsibility).
- **Big ideas in science**: Emphasis on core concepts and their application rather than overwhelming detail. Ensuring there is clarification as to what the Big Ideas are.

2. Creativity and innovation

- **Meta skills**: More opportunities to integrate creativity, problem-solving, and innovation into science education.
- **Beyond exams**: A shift from a summative assessment focus to nurturing curiosity, exploration, and lifelong learning.
- **Sustainability focus**: Greater emphasis on teaching climate change and sustainability through creative, interdisciplinary approaches.

3. Equity and access

- **Digital divide**: Addressing inequity in access to technology and resources, particularly for marginalised groups.
- **Inclusive curriculum**: Ensuring curriculum is accessible and meaningful for all learners, including those with additional support needs (ASN) and neurodivergent students.
- **Diverse role models**: Highlighting diverse figures in STEM to inspire underrepresented groups (e.g., girls, nonbinary students).

4. Skills for learning, life, and work

- **Career awareness**: Better integration of STEM career pathways and opportunities into learning.
- **Skills application**: Stronger links between science, life, and work skills to develop a holistic understanding.
- **Collaboration and communication**: Embedding teamwork, assertiveness, and effective communication into activities (e.g., group projects, STEM challenges).

5. Engagement and relevance

- **Enquiry-based learning**: Using open-ended questions and real-world problems to spark curiosity and deeper learning.
- **Outdoor and place-based learning**: Leveraging the natural world and local contexts to make science relatable.
- **Interdisciplinary learning (IDL)**: Combining science with other subjects like social studies and technology for a more connected experience.

6. Resilience and growth mindset

- **Learning through failure**: Encouraging experimentation and perseverance through challenges to foster resilience.
- **Risk-taking and problem-solving**: Creating safe spaces for students to take risks and explore solutions independently.

7. Assessment and implementation

- **Balancing content and skills**: Shifting focus from factual recall to developing transferable skills like analytical thinking and creativity.
- **Alignment to capacities**: Making the four capacities explicit in teaching and assessment, ensuring they guide learning rather than existing as background ideas.
- **Teacher development**: Providing professional development (CLPL) to support teachers in implementing these capacities effectively.

These themes point to a need for a more flexible, inclusive, and skills-focused approach to science education.

Key themes from teacher responses on additional information submitted by members of the collaboration group.

The responses highlight opportunities, challenges, and insights regarding how the **four capacities** are addressed and supported within the current educational framework.

1. Early years and child-led learning

- **Play-based learning**: Early learning and childcare practitioners see the potential for child-led learning to naturally develop aspects of the four capacities.
- **Familiarity with capacities**: Introducing the four capacities to young learners in simple, meaningful ways lays the foundation for future learning.
- **Collaborative and creative learning**: Opportunities exist to develop opinions, assess risks, and evaluate environmental issues even in early years.

2. Science capital and community engagement

- **Improving science capital**: There is a call for increasing science awareness and relevance not just for learners but also for families and practitioners.
- **STEM Ambassadors and external engagement**: Opportunities to connect with industry professionals and competitions enhance learning experiences and support the capacities.
- **Science buddies scheme**: S5/S6 pupils gain leadership and communication skills through mentoring or placements in the community.

3. Curriculum clarity and guidance

- **Lack of clarity**: Teachers feel the need for clearer guidance on embedding the four capacities into the curriculum, especially without making them the sole focus.
- **Progression and success**: Better communication of learning levels and progression to learners and parents is essential for understanding success.
- **Big Ideas approach**: Using overarching questions and themes (e.g., Evolving 5-19 Biology framework) integrates the capacities into practical and conceptual science learning.

4. Practical applications of the capacities

- **Interconnected capacities**: Teachers often find it difficult to isolate specific capacities in activities as they frequently overlap (e.g., critical thinking supports both Confident Individuals and Responsible Citizens).
- **Examples of integration**:
    - **Confident individuals**: Encouraging leadership through projects like Young STEM Leaders and public presentations.
    - **Responsible citizens**: Discussing the applications and ethical implications of science.
    - **Successful learners**: Developing practical skills and critical thinking in varied science challenges.
    - **Effective contributors**: Fostering communication and teamwork through STEM assemblies, competitions, and project-based learning.

5. Real-world relevance and critical thinking

- **Controversial topics**: Engaging students in discussions about contentious scientific and technological issues (e.g., ethics, sustainability) to develop critical thinking.
- **Risk and safety awareness**: Building awareness of risks and hazards through activities at all levels, from Early Years to Advanced Higher.
- **Challenging misconceptions**: Using science education to debunk myths and develop informed decision-making skills.

6. Leadership and collaboration

- **Peer-led learning**: Older pupils leading sessions for younger peers or families demonstrates leadership while fostering confidence and communication.
- **Collaborative projects**: Group challenges and whole-school STEM events provide opportunities for teamwork and creativity.

7. Progression across levels

- **Early to advanced skills**: Activities range from simple risk assessment in early years to advanced lab skills and health sector awareness in secondary.
- **Varied delivery**: A mix of teaching methods, including projects, competitions, and external partnerships, supports different capacities and learning styles.

This reflects a shared vision for a more integrated, meaningful, and equitable science curriculum that supports holistic development

Analysis of output from Session 3
What does a future-oriented sciences curriculum look like?

Top words/phrases for a future oriented science curriculum:

- Sustainability
- Adaptability
- Critical thinking
- Inclusivity
- Wellbeing

Summary of Critical themes

Here's a summary of the top four themes from the analysis:

1. Critical thinking and information evaluation

- **Key skills:** Critical evaluation of information, identifying bias, analysing evidence, and discerning fact from fiction in the digital world (e.g., fake news, misinformation).
- **Focus:** Developing research skills, dealing with uncertainty, and fostering scientific literacy to evaluate evidence critically.
- **Application:** Applying these skills to tackle global challenges and make informed decisions, particularly in science and technology contexts.

2. Sustainability, climate change, and global citizenship

- **Key concepts:** Green skills, renewable energy, sustainability, and climate change education.
- **Focus:** Encouraging learners to think globally, adopt a responsible and sustainable mindset, and understand their role in a global ecosystem.
- **Application:** Curriculum should integrate STEM approaches to address challenges like climate change and promote solution-oriented thinking.

3. Creative and adaptive problem solving

- **Key skills:** Creativity, innovation, adaptability, and problem-solving.
- **Focus:** Using meta-skills to develop creative, practical solutions to current and future challenges, like pandemics or fast-paced technological changes.
- **Application:** Inquiry-based and interdisciplinary approaches to learning, fostering curiosity, imagination, and the ability to apply knowledge across various contexts.

4. Well-being, resilience, and ethical understanding

- **Key Focus:** Strategies to support mental health and resilience for both learners and staff.
- **Ethical perspective:** Empathy, understanding socio-scientific and moral justice dilemmas, and promoting respectful behaviour toward oneself, others, and the environment.

- **Application:** Balancing digital and human interactions, maintaining equity in access to education, and promoting a curriculum that values human well-being alongside technical skills.

These themes emphasise a holistic, forward-thinking educational framework that balances critical thinking, sustainability, adaptability, and well-being.

Summary of <u>Very Important</u> themes

Here's a summary of the top four themes from the analysis:

1. Sustainability and global citizenship

- **Key concepts:** Sustainable living, recycling and reuse, climate change awareness, and understanding the global impact of personal and local decisions on biodiversity, health, and the environment.
- **Focus:** Promoting environmental responsibility and instilling hope about the future, with an emphasis on sustainability as a core part of the curriculum.
- **Application:** Encouraging action-oriented learning and fostering global citizenship by helping students see their place in the world and their ability to contribute positively.

2. Critical thinking, scientific literacy, and systems thinking

- **Key skills:** Understanding the scientific method, evaluating evidence, spotting misinformation, and exploring how science connects to societal and non-human contexts (systems thinking).
- **Focus:** Building scientific literacy and science capital to make informed decisions, solve problems, and evaluate the role and impact of science on society.
- **Application:** Developing resilience through experimentation and failure, while fostering curiosity and critical thinking for lifelong learning and innovation.

3. Adaptability, resilience, and transferable skills

- **Key skills:** Adaptability to rapid change, resilience in testing new ideas and facing challenges, and confidence in learning new skills.
- **Focus:** Equipping students with transferable skills for future job markets, such as problem-solving, collaboration, and effective communication.
- **Application:** Linking curriculum content to real-world careers and STEM opportunities, enabling learners to adapt to sudden changes and uncertainties.

4. Inclusivity, accessibility, and personalisation

- **Key concepts:** Making the curriculum flexible, inclusive, and accessible to address social inequalities and reflect diverse learners.
- **Focus:** Promoting equality, diversity, and personalised learning pathways, allowing students to choose how they demonstrate their learning (e.g., practical vs. theoretical assessments).
- **Application:** Ensuring all learners feel represented, have access to opportunities, and can connect their education to local, national, and global contexts.

These themes highlight the importance of sustainability, adaptability, inclusivity, and critical thinking in preparing students for a rapidly changing world.

Summary of Important themes

Here’s a summary of the top four themes from the analysis:

1. Sustainability and green skills

- **Key focus:** Promoting sustainable living, renewable energy, and understanding the importance of climate solutions, not just climate change.
- **Application:** Developing "green skills" to prepare students for emerging industries tied to climate action and renewable energy. Encouraging sustainable mindsets for lifelong learning and understanding global inequalities in resource distribution (e.g., Global North vs. South).
- **Integration:** Embedding sustainability into the curriculum through practical experiences, engineering, and problem-solving tasks.

2. Critical thinking, scientific literacy, and data skills

- **Key focus:** Fostering critical thinking, the ability to evaluate sources, analyse data, and use scientific methods to address challenges.
- **Application:** Teaching students how to assess the reliability of information, navigate misinformation, and apply scientific literacy in various contexts (e.g., health, quantum computing, climate, and technology).
- **Connection:** Bridging foundational science knowledge with real-world applications to cultivate scientifically literate citizens who can make informed decisions.

3. Adaptability, innovation, and future readiness

- **Key focus:** Preparing students for a rapidly changing world through skills like adaptability, resilience, and creativity.
- **Application:** Encouraging innovation and entrepreneurial thinking while fostering the ability to work with new technologies (e.g., AI, smart technologies) and emerging fields (e.g., biotechnology, precision medicine).
- **Emphasis:** Building transferable skills for future careers, enabling learners to navigate political instability, technological advances, and environmental changes.

4. Social intelligence, well-being, and inclusivity

- **Key focus:** Supporting mental health, fostering empathy, and developing social intelligence for future collaboration and community engagement.
- **Application:** Promoting inclusivity and accessibility in education, offering personalised learning pathways, and encouraging teamwork, effective communication, and self-regulation.
- **Context:** Addressing societal challenges such as online safety, global inequalities, and the importance of values, morality, and relationships within communities.

These themes underscore the need for an education system that balances sustainability, adaptability, critical thinking, and social responsibility to equip students for the challenges of the future.

Analysis of output from Session 4
Sharing and discussing within sector groups

Summary of responses to Question 1 – What are your key messages for the core group?

This analysis is presented by sector.

Sector: ASN

1. **Need for specific ASN curriculum -** The call for a tailored curriculum that meets the needs of ASN (Additional Support Needs) learners.
2. **Inadequate learning outcomes -** Current learning outcomes are not appropriately designed or written for ASN learners.
3. **Science curriculum for ASN learners -** A question about whether a new science curriculum can effectively cater to both ASN learners and their teachers.
4. **Under-representation of ASN Learners -** Concerns about ASN learners being under-represented in educational resources and opportunities.
5. **Resources for ASN learners -** The need for specific resources, such as symbolised content (e.g., Boardmaker), to support ASN learners.
6. **Limited senior phase options -** A request for more options in the senior phase (National 2 level and below) for ASN learners to achieve national qualifications.
7. **Course progression -** The importance of ensuring smooth progression from National 1 to National 2 levels with consistent topics and units.
8. **Inaccessibility of current 3-18 framework -** Highlighting that the current 3-18 framework is not ASN-friendly and may not accommodate the unique needs of these learners.
9. **Value of Experiences over Outcomes -** Emphasis on valuing the learning experiences of ASN learners rather than focusing solely on formal outcomes.
10. **Equity in progression -** The need for more equitable progression opportunities, such as starting Skills for Work before SCQF Level 4 to ensure inclusivity and accessibility for ASN learners.

Sector: ELC

1. **Curriculum flexibility -** The need for a more flexible curriculum, allowing child-led approaches and avoiding overly specific structures.
2. **Transferable skills -** Emphasis on identifying and fostering transferable skills across curriculum areas.
3. **Inclusivity -** Focus on making the curriculum more inclusive, particularly for ASN (Additional Support Needs) learners
4. **Gender equality -** Challenging stereotypes and promoting gender equality within the curriculum.

5. **Curriculum changes -** The need for changes to the Experiences and Outcomes (Es & Os) to better align with current needs.
6. **External partners involvement -** Importance of engaging external partners like STEM Nation and STEM Awards in the curriculum.
7. **Practitioner experience -** Acknowledging the importance of practitioner experience and entry points, as well as commonalities between sectors.
8. **Valuing voices -** Ensuring that all voices, including those from diverse sectors, are heard and valued equally.
9. **Critical thinking and skills development -** Emphasising the need for critical thinking and skills development at all educational levels, especially at early levels with more freedom and time.
10. **Pressure of testing -** Concerns that the pressure for testing in later stages detracts from time dedicated to scientific thinking and problem-solving.
11. **Creativity and curiosity -** Placing creativity and curiosity at the heart of the curriculum, valued across all sectors.
12. **Transitions -** Highlighting the importance of smooth transitions, particularly from Early Learning and Childcare (ELC) to Primary 1.
13. **Child development -** Considering child and neurological development at all stages of learning.
14. **Skills in primary education -** Recognition of the strong skills-based approach in primary education.
15. **Supportive digital tools -** The need for specific digital tools like Glow/Teams for ELC, and support tailored to geographical areas.
16. **Facilitators' role -** Acknowledging the value of facilitators in supporting the curriculum development process.

Sector: Primary

1. **Curriculum simplification and progression**
   - Simplify and declutter the science curriculum.
   - Focus on core science knowledge and skills, with clear progression from ELC to secondary.
   - Reduce repetition and ensure meaningful continuity across stages.
2. **Core skills development**
   - Emphasise practical skills like measuring, planning investigations, and research.
   - Link skills to Experiences and Outcomes (Es & Os) and integrate with the four capacities.
3. **Engagement and innovation**
   - Foster curiosity through fun, practical, and project-based learning.
   - Use meaningful, relevant contexts to make science adaptable and future-focused.
4. **Resource access and teacher confidence**
   - Provide centralised resources (e.g., Clickview, SSERC) and CLPL for teacher support.
   - Build teacher confidence to deliver high-quality science lessons.
5. **Interdisciplinary learning (IDL)**
   - Incorporate STEM into IDL with literacy, numeracy, and extra-curricular activities.

6. **Assessment and transitions**
    - Develop clear methods for assessing and moderating science.
    - Support transitions between ELC, primary, and secondary levels.

7. **Programmes and collaboration**
    - Establish a 3-year science programme with reduced content overload.
    - Leverage external resources and partnerships like Crest, Climate Starter, and STEMovators.

Sector: Secondary (Biology)

1. **Curriculum depth and ambition**
    - Focus on detailed, ambitious science curriculum for BGE, prioritising depth over breadth.
    - Spiral approach for key biology themes and practical skills development.
2. **Assessment and reporting**
    - Need for clear, consistent assessment criteria and moderation guidelines for accurate progression and reporting.
    - National consistency in reporting and assessment levels.
3. **Transition and continuity**
    - Ensuring smooth transitions from primary to secondary, with consistency across stages.
    - Considerations for timetabling and lesson frequency.
4. **Qualifications and senior phase**
    - Proper National 4 qualification, not just units.
    - Overhaul of Advanced Higher biology content for relevance and coherence.
    - Discussion on the dual Higher Biology awards and their accessibility.
5. **Biology content and relevance**
    - Ongoing reviews of biology structure and content to keep it current.
    - Emphasis on key biological concepts (e.g., evolution, genetics, body systems, ecology) and their relevance.
    - Link to broader topics like health & wellbeing and science of learning.
6. **Role of SQA and learner goals**
    - Desire for educators to have more influence over SQA content and exam format.
    - Focus on making learners biologically literate, whether they continue biology or not after BGE.

Sector: Secondary – Chemistry

1. **Curriculum simplification and focus**
    - De-cluttering the curriculum, focusing on key topics and skills.
    - Emphasis on keeping content clear, simple, and futureproof to remain relevant.
2. **Progression and continuity**
    - Ensuring clear progression from early learning to the senior phase, with a focus on skills over content.

- Identifying key concepts and techniques at each level for effective learning and assessment.

3. **Assessment and flexibility**
   - Exploring multiple assessment methods, including oral literacy and scientific writing.
   - Building flexibility and adaptability into the curriculum, with room for pupil choice and deeper learning.
4. **Science in early education**
   - Introducing more chemistry in primary and early years to build foundational knowledge.
5. **Time for learning**
   - Reducing content to allow more time for in-depth learning, interdisciplinary events, and student choice.

Sector: Secondary – Physics

1. **Curriculum structure and clarity**
   - Need for a cohesive, hierarchical curriculum with clear expectations for task completion and skills development.
   - Es & Os should be less prescriptive, with a focus on depth and clear success criteria.
2. **Assessment and resources**
   - Assessment should be clear, supportive, and avoid duplication.
   - Use national resources and projects to reduce reinventing the wheel.
   - Incorporate electronic and digital assessments to check basic science knowledge and skills.
3. **Skills and qualifications**
   - Emphasis on skills development from ELC to Primary, with accessible science qualifications for all students.
   - SQA should align with the curriculum, not dictate it.
4. **Support for educators**
   - Need for resources and CLPL to support primary and non-subject specialists with exemplified lessons.
   - A writing team should develop a core, adaptable curriculum with local context and cross-subject connections.
5. **STEM focus and curriculum management**
   - Ensure core ideas are achievable at each stage, with a STEM context that supports creativity.
   - Curriculum must be manageable, with proper support and guidance.

Sector: Partners

1. **Core knowledge and clarity**: Specify core knowledge to simplify assessment and clarify what is included in the curriculum.
2. **Skills development**: Focus on early development of process-related skills, including practical and analytical skills.
3. **Source reliability**: Emphasise the importance of source reliability in learning.
4. **Teacher education**: Highlight the importance of continuous teacher education beyond just initial training.

Summary of responses to Question 2

What are the key takeaways for your sector?

This analysis gives key themes by sector.

ASN

1. **Progression**: Focus on ensuring clear and consistent advancement in learning.
2. **Equity**: Emphasis on fairness and equal opportunities for all learners.
3. **Validation of learning**: Importance of recognising and confirming the value of learners' experiences and achievements.

ELC

1. **Valuing contributions:** Recognition that participant voices are valued.
2. **Anticipation of positive change**: Optimism about upcoming improvements and progress.
3. **Transitions and core frameworks:** Focus on smooth transitions across educational stages. Emphasis on the 4 capacities as a central and effective framework.
4. **Skills-based education:** Appreciation for skills-based approaches across all levels.
5. **Collaboration and shared values:** Alignment of values and views across sectors. Importance of cross-sector collaboration and information sharing.
6. **Curriculum development:** Simplifying Experiences and Outcomes (Es & Os) to make them more inclusive, age-appropriate, and stage-appropriate.

Primary

1. **Positive change and solution focus:** Emphasis on preparing for change with a solution-oriented and positive mindset. Acknowledging that change will take time, but it’s underway.
2. **Curriculum improvement:** The need to update and make the curriculum more explicit. Refocusing on the four capacities and linking them to skills and job readiness.
3. **Practitioner involvement and collaboration:** Valuing practitioner voices and ensuring their input is heard by Education Scotland. Collaborative, practitioner-centred approach with broad representation.

4. **Skills and scientific literacy:** Strong focus on scientific literacy and skills development, including meta-skills. Highlighting the importance of science as fun and engaging, not intimidating.
5. **Resources and STEM projects:** Encouraging the use of available resources and promoting cluster-wide STEM projects.

Secondary - Biology

1. **Awareness and involvement:** Awareness of the process and practitioners' key role in driving change.
2. **Access to information:** Importance of knowing where to find up-to-date information.

Secondary - Chemistry

1. **Stakeholder engagement:** Education Scotland is listening to and considering feedback.
2. **Curriculum framework:** The four capacities will remain central.
3. **Key issues:** Identification of important issues for curriculum development.
4. **Access to information:** Availability of information about the process and relevant websites.
5. **Adaptability:** Openness to change and flexibility in the curriculum.
6. **Skills and future-proofing:** Focus on skill development and ensuring the curriculum remains relevant for the future.

Secondary – Physics

1. **Support for transitions:** Focus on aiding smooth transitions between educational stages.
2. **CLPL (Career-long professional learning):** Provide CLPL to support assessment, literacy, and skills development, as well as collaboration between sectors.
3. **Skills development:** Emphasise a renewed focus on skills while balancing creativity and exam techniques.
4. **Communication and collaboration:** Foster regular, two-way communication between core groups and practitioners to share practice and feed into the process.

Partners – FE/HE/SQA

1. **Real-world relevance:** Emphasis on addressing real-world challenges, such as climate change, in the curriculum.
2. **Collaboration with industry and higher education:** Industry and higher education should facilitate conversations and collaboration with schools.
3. **Understanding the four capacities:** Importance of understanding how the four capacities shape student development.
4. **Collaborative learning and positivity:** Value in learning from each other, being un-siloed, and fostering positive discussions about change.
5. **Quality facilitation:** High-quality facilitation and productive discussions were key to the process.

6. **Role of Learned Societies:** Learned societies offer starting point documents and welcome input from the collaboration group.
7. **Assessment clarity:** Still need clarity on how assessment fits into the overall approach