

THE GEOLOGICAL SOCIETY OF LONDON

SUBMISSION TO DEPARTMENT FOR EDUCATION CONSULTATION: REFORM OF THE NATIONAL CURRICULUM IN ENGLAND

1. The Geological Society is the UK's learned and professional body for geoscience, with more than 10,500 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government with a broad range of perspectives on policy-relevant science, and the Society is a leading communicator of this science to government bodies, those in education, and other non-specialist audiences. This submission has been prepared in consultation with our Education Committee, whose members include school teachers, university lecturers, other educationalists and industry geoscientists, and was also informed by input from others in the Earth science education community.

Content of draft programmes of study

2. In December 2011, the Geological Society, together with the Royal Geographical Society, the Earth Science Teachers Association, the Geographical Association and the Royal Meteorological Society wrote to Department for Education officials regarding the review of the National Curriculum for England. We highlighted the importance of Earth science in the school curriculum, while recognising that it would not be the subject of a separate programme of study, and that topics would be split across the Geography and Science programmes of study. We provided a grid setting out the key topics in Earth science (in the broadest sense – including atmospheric science, for instance) which all school students should be taught, both to equip them as well-informed 21st century citizens, and to stimulate the next generation of trained Earth scientists whose skills will be needed to generate economic wealth and tackle global challenges. This grid identified the programme of study and Key Stage (KS) in which we thought it most appropriate to introduce each topic.
3. The Geological Society is pleased to see that many of the recommendations set out in this grid have been adopted in the new draft National Curriculum. We recognise the difficulty inherent in appropriately assigning Earth science topics across the Geography and Science programmes of study, so as to introduce key ideas in Earth science while ensuring that the overall programmes of study are cohesive. A particular challenge is to ensure that related content in geography, physics, chemistry and biology is appropriately linked. Nonetheless, we have some significant concerns, particularly regarding the limited Earth science content of the KS3 and KS4 Science programmes of study. Furthermore, some

of the Earth science content at secondary level (both in Geography and Science) appears disjointed, and the key concepts to which it relates are not sufficiently clearly identified.

4. The Earth science components of the KS1 and KS2 Science and Geography programmes of study are appropriate to their respective age groups, and are well structured. We are pleased to see the emphasis placed on fieldwork in physical geography, at KS1-3.
5. As noted above, we are concerned that the Earth science content proposed for KS3 and KS4 lacks cohesion. Greater emphasis should be given to key concepts such as plate tectonics (which is mentioned in passing) and the rock cycle (which is not explicitly mentioned). Rather than just encounter disparate elements of these topics, for example as explanatory factors behind geographical processes, it is important that students know that they are being taught the 'big ideas' of a vital branch of science. These fundamental unifying concepts should be taught as part of the Science programme of study, even if they are also mentioned in Geography, because to understand them, students must deploy the scientific skills rightly identified in the 'Working scientifically' sections of the draft curriculum, which trained science teachers (whether or not they have specialist knowledge of Earth science) are more likely to be able to convey effectively.
6. The curriculum should use the names of the key concepts in Earth science, and should also explicitly mention 'geology'. We believe that learning outcomes in science should include knowing what different types of scientist (besides chemists, physicists and biologists) do. This is an important step in raising students' awareness of the opportunities which exist for further study and careers in a wide range of sciences and engineering. The future prosperity and well-being of the UK will depend on the supply of trained personnel in these fields.
7. The rock cycle is not explicitly mentioned in the draft curriculum, although isolated elements which constitute it are mentioned in KS2 Science and KS3 Geography. Metamorphism / metamorphic rock is not mentioned at all. The rock cycle should be identified as a topic in KS3 Chemistry, following on from the simple treatment of formation of igneous and sedimentary rock in KS2 Science. It would be sensible to retain the reference to rocks, weathering and geological timescales in KS3 Geography, as elements of geographical processes and explanatory factors for geographical features. The emphasis in the Science programme of study should be on the rock cycle as an evidence-based explanatory model.

8. We are pleased to see that plate tectonics is mentioned in the draft curriculum, but we note that this is only among a mixed list of specific geographical features and processes in KS3 Geography. It is quite right that plate tectonics should be referred to at this stage, for example to explain the location of volcanoes and earthquakes. But it is also important that students understand it as a unifying scientific theory in Earth science, which is based on observed evidence and explains much of how our planet works. We believe that this is best done in KS4 Physics, where it would complement the existing content on the internal structure of the Earth (in relation to pressure, temperature and depth) and on sound waves in matter (where we are pleased to see seismic detection, both of earthquakes and of subterranean structures, explicitly mentioned). The deeper understanding gained in this context (and appropriate to this age group) would build on the simpler process-based reference to plate tectonics at KS3 Geography.
9. Few Earth resources are explicitly mentioned. Quite rightly, sourcing water is identified as an important topic (in Chemistry KS4). It seems odd to pick out calcium carbonate, but not to mention other mineral resources (e.g. metal ores). We suggest that this bullet point is replaced with: 'minerals as raw materials, e.g. metal ores, limestone as a building material'. There is also no explicit mention of fuels sourced from the Earth (though there is a general reference to fuel sources, with no further detail, in KS3 Physics). Fossil fuels (oil, gas, coal) are among the most important resources we get from the Earth. Neither the carbon cycle (mentioned in KS4 Biology) nor carbon capture and storage (CCS) (mentioned in KS4 Chemistry) make much sense without considering the formation, extraction and use of fossil fuels, and possible alternative energy sources. The carbon cycle should be addressed in KS4 Chemistry, in addition to any study of it in biology, as a unifying concept in which context fossil fuels, climate change (and indeed the formation and use of calcium carbonate) can be understood.
10. We are pleased to see that KS3 Chemistry will include the composition of the Earth and its atmosphere, changes to the atmosphere over geological time and the climate impacts of anthropogenic carbon emissions. 'Efficacy of recycling' seems out of place here, as it does not clearly relate to the preceding bullet points. It would be more relevant to highlight sustainable energy use, or resource use more widely (which would of course include recycling). Issues such as sustainability and the human impacts of climate change might be more sensibly addressed as part of human geography – use of resources is mentioned in KS3 Geography, where these concepts could also be highlighted – but this need not preclude also raising these issues in chemistry.

Delivery of the new curriculum

11. In most cases, Earth science content will be taught by non-specialist teachers, whether as part of the Science or Geography programmes of study. They may lack confidence in delivering content with which they are less familiar. These challenges may be greater for geography teachers who specialise in human geography, especially if key scientific concepts are to be taught principally within geography. The Geological Society, along with other organisations such as the Earth Science Teachers Association (ESTA) and the Earth Science Education Unit (ESEU), is committed to supporting teachers without an Earth science background who are expected to deliver such content. For example, the Society runs an annual training course for teachers (the Geoscience Education Academy), which is actively supported by industry and academia, and we have developed significant online teaching resources on the rock cycle and plate tectonics. We also stand ready to work with examination boards as they develop new qualifications in light of the new National Curriculum and other education policy developments.

12. The Geological Society is pleased to have discussed development of the curriculum over recent months, and is grateful for the opportunity to respond to the present consultation. We would be happy to discuss further any of the issues raised in this submission, or to help in any other way we can as the review continues.

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