IMPROVING SECONDARY SCIENCE

Audit Tool

This Red Amber Green (RAG) self-assessment guide accompanies the Education Endowment Foundation's report, Improving Secondary Science, which sets out seven evidence-based recommendations on the effective secondary science teaching.

It describes what 'ineffective', 'improving' and 'exemplary' practice can look like in relation to all seven recommendations, as well as teacher subject knowledge, which is required to ensure the other recommendations can be successfully implemented.

It can be used as part of an initial audit process to establish what current practice looks like, as well as to monitor progress towards the development of more effective practice.

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OVERARCHING THEME
Teacher Subject Knowledge

	Ineffective	Intermediate	Exemplary
Teacher subject knowledge	Teachers have significant gaps in their subject knowledge. Teachers do not share knowledge across the department.	Teachers have good subject knowledge in their specialist subject, but some gaps in specific topics and in other science subjects. There is some support for development of subject knowledge within the department, but limited access to external opportunities.	Teachers understand all of the subject knowledge required to teach the science subjects they teach. There is support across the department for teachers teaching outside of their specialism and they have access to high quality external CPD as required.
Teaching strategies for science	Teachers have limited knowledge of different teaching strategies for science and there are significant gaps (in specific subjects/ topics). Teachers do not share knowledge of different strategies and their use across the science department.	Teachers have good knowledge about teaching strategies in some areas of science, but there are gaps (in specific subjects/topics). Sharing of teaching strategies and their uses across the science department is not commonplace.	Teachers have a thorough knowledge of teaching strategies across all science subjects that they teach. This covers all of the recommendations in the guidance report, including preconceptions and how to elicit and address them, modelling, and practical work.

RECOMMENDATION 1
Preconceptions

	Ineffective	Intermediate	Exemplary
Developing knowledge about misconceptions	Many teachers are not knowledgeable about misconceptions in science and don't know where to find this information.	Teachers' knowledge of common misconceptions in science is inconsistent and they are not confident outside their specialism. Misconceptions are not considered as a standard part of planning.	Teachers are aware of the possible misconceptions in science. Knowledge is shared across the different science specialisms. Teachers know where to find this information and it is a standard part of topic and lesson planning.
Uncovering pupil preconceptions	Teachers do not know how to uncover pupil preconceptions and don't do this as standard practice.	Teachers understand the importance of uncovering preconceptions and have started to use pedagogies to do this.	Uncovering pupil preconceptions is a core part of topic and lesson planning. Teachers use a number of different pedagogies effectively, including group discussion and diagnostic questions.
Challenging misconceptions	Teachers are not confident in resolving misconceptions.	Teachers understand some pedagogies for resolving misconceptions, including using cognitive conflict and apply this in lessons.	Teachers understand that misconceptions are difficult to shift. They revisit these at different points and use a range of pedagogies to address them, including cognitive conflict, group discussion and argumentation.
Following misconceptions to resolution	Teachers use summative assessment to check if misconceptions have been resolved.	Teachers use formative assessment to check that misconceptions have been resolved and adjust teaching if they haven't.	Teachers use a range of formative assessment strategies (including low stakes quizzes, class tasks, diagnostic questions and discussion) to check that misconceptions have been resolved. If they haven't teaching is adjusted. Teachers understand that misconceptions are 'sticky' and test for these after a 'forgetting gap'.

RECOMMENDATION 2
Self-Regulation

	Ineffective	Intermediate	Exemplary
Helping pupils become proficient in the metacognition cycle	Limited metacognitive approaches are used to help pupils plan, monitor and evaluate their own learning.	Some metacognitive approaches are used, but regular opportunities for pupils to practise and develop their skills are needed.	Metacognitive strategies are used effectively and pupils have extensive opportunities to practise metacognition.
Developing how pupils think through problems	The development of pupil thinking in new areas is not planned and pupils are not provided with models of how to think.	When pupils first encounter new types of problems or ways of thinking teachers use worked examples and model their own thinking. There is however an over-reliance on this and teachers don't scaffold learning so that pupils become independent over time.	Teachers carefully plan how to introduce new problem solving techniques and ways of thinking. Teachers use worked examples and model their own thinking. These scaffolds are carefully removed over time so that pupils become independent and so that deliberate difficulty is introduced.
Providing challenge and ensuring motivation	The level of challenge in lessons can be inappropriate. Pupils are unmotivated towards science.	The level of challenge is appropriate for the pupils. Pupils are generally motivated towards science.	Pupils are stretched by working on challenging concepts with support from adults and peers. Pupils are motivated towards science.
Promoting metacognitive talk and dialogue in the classroom	Teachers struggle to orchestrate productive dialogue in classrooms.	Classroom discussions take place but some pupils refrain from taking part. Limited metacognitive talk takes place.	Productive classroom discussion takes place frequently. Metacognitive talk takes place and pupils are regularly encouraged to justify answers and support is given to help pupils strengthen arguments.

RECOMMENDATION 3
Modelling

	Ineffective	Intermediate	Exemplary
Selecting the models you use	Models are not chosen with care. They may be used when they're not needed, adding unnecessary complexity, or the concept that the model is based on may be unfamiliar to pupils meaning that the model could inhibit learning.	Models are used at appropriate times and are chosen to ensure they're relevant to pupils and don't add unnecessary complexity. Teachers teaching outside of their specialism find the selection of models difficult.	Models are used at appropriate times and are chosen to ensure they're relevant to pupils and don't add unnecessary complexity. Teachers reflect on the success of the models they've used on a regular basis and update their repertoire. Teachers across different specialisms share the models they use.
Using models to develop deeper understanding	How models are used as part of learning sequences isn't considered and the model is not linked to the underlying theory.	Models are appropriately linked to the knowledge being taught and help pupils to understand ideas that they can't directly experience.	Models are linked to the knowledge being taught and help pupils to understand ideas that they can't directly experience. Models are used to link things that pupils can observe to the underlying explanations for these things.
Teaching pupils about the nature of models and encouraging them to critique them	Pupils learn the model rather than the idea it is depicting. Pupils think that the model is a direct copy of reality.	Pupils know that models are not direct copies of reality and know that they're used to help develop scientific understanding. Pupils are encouraged to critique models and identify the similarities and differences between the model and the concept.	Pupils know that different models can be used to explain different elements of an idea. They are encouraged to critique models and can also make suggestions for improvements. They are able to compare alternative models of the same idea and identify the different strengths and weaknesses.

RECOMMENDATION 4
Memory

	Ineffective	Intermediate	Exemplary
Understanding the importance of memory	Teachers do not understand the importance of supporting pupils to memorise information.	Teachers understand the importance, but have a limited view of this and see it as rote learning.	Teachers understand the importance of supporting pupils to commit subject knowledge to long term memory to free up working memory.
Pay attention to cognitive load	Tasks often include too much new information meaning that pupils find it hard to learn what is intended.	Teachers know it is important to pay attention to cognitive load, but find it hard to apply this to their lesson planning, or can only apply it to a limited range of task types.	Teachers structure tasks so that the amount of new information pupils need to process is limited and manageable. They know how to apply this to a range of task types (problem solving, practical work, etc.).
Revisit knowledge after a gap	Curriculum plans only cover topics once and ideas are not revisited.	Curriculum plans allow for some short term recapping, but longer term opportunities are limited.	The curriculum plan includes opportunities for pupils to revisit skills and knowledge after suitable gaps, including recapping the previous lesson and reviewing over longer time points.
Provide opportunities for pupils to retrieve knowledge	Opportunities for pupils to retrieve knowledge is limited to end of topic tests, or some whole class questioning.	Retrieval practices are used often. Teachers use a number of strategies, although these can be repetitive.	Retrieval practises are regularly used (in every lesson) to support pupils accessing previously learnt knowledge. A range of task types are used including, low stakes test, concept map, flashcard activities and discussion.
Encourage elaboration	Pupils are not encouraged to expand on what they have learnt, or to link it to other learning.	Pupils are sometimes encouraged to expand on what they have learnt.	Regular opportunities are given for learners to explain their understanding, making links and connecting to other prior learning.

RECOMMENDATION 5
Practical Work

	Ineffective	Intermediate	Exemplary
Using practical work purposefully	Teachers use practical work as a lesson activity rather than thinking about the reason that they are using it.	Teachers understand the different purposes that practical work can have. They consider why they are doing a particular activity and make this clear to pupils.	Teachers carefully select practical activities to support the aims of the lesson. They are clear about the purpose of the practical activity and make this explicit to pupils. Teachers use a range of practical activity types according to the purpose, this includes virtual experiments and open-ended investigations.
Linking practical work with other learning	Practical work is seen as a stand alone activity and is not clearly linked to the rest of the lesson. Teachers expect pupils to learn scientific concepts through practical activities alone.	Teachers link the practical activity to the aims of the lesson. They remind pupils through the activity what they should be observing and the ideas they should be using.	Teachers link the practical activity to the aims of the lesson. They remind pupils through the activity what they should be observing and the ideas they should be using. After the activity teachers discuss with pupils what was observed and how this adds to their understanding of the ideas being taught.
Using practical work to develop scientific reasoning	Limited opportunities for scientific inquiry are provided.	Opportunities for scientific inquiry are provided but these could be unfocused or are often pupil-lead.	Opportunities for scientific inquiry are frequent. These are teacher-lead and focus on skills which develop science specific reasoning skills.

RECOMMENDATION 6
Language of Science

	Ineffective	Intermediate	Exemplary
Explicitly teach vocabulary and focus on tricky words	Limited emphasis is placed on recapping keywords and there is very limited explicit teaching of scientific words.	Teachers are aware of the different ways to teach scientific words and sometimes encourage pupils to use them, but this is done inconsistently. Keywords are not referred to regularly in lessons	The explicit teaching of scientific words is thoroughly thought through. There is a focus on tricky words. Reinforcement is used as much as possible in lessons
Showing pupils how words are built up and their links	Pupils are rarely taught how words are built up.	Pupils are sometimes taught how words are built up.	Pupils are routinely taught how words are built up. This includes teaching roots, prefixes and suffixes and the meaning of different morphemes - these are used to show the links between words.
Using activities to engage pupils with scientific texts	Teachers have little or no awareness of activities to engage pupils with reading. Activities used are simple word completions or word searches. Pupils are not exposed to a range of texts.	Teachers have limited awareness of activities to engage pupils with reading. Activities are used occasionally get the pupils to engage with scientific texts. Texts are not always carefully selected and sometimes do not match the pupil's level.	Teachers have good awareness of activities to engage pupils with reading. The activities used challenge pupils to think about science during their reading. Texts are carefully selected so that they match pupils level, but are challenging and interesting.
Developing the scientific writing skills of pupils	Pupils are not provided with the opportunity to write about science.	Teachers provide some opportunities for writing for different purposes and audiences. Writing is not always revisited to include revising and editing, which may mean pupils don't progress as writers. Frameworks are used, but their use is not carefully planned and there may be an over reliance on them.	Teachers provide many opportunities for pupils to write for different audiences and purposes. They help pupils to approach writing as a process, include planning the work and revising and editing it. Frameworks are used to support pupils writing, particularly when pupils are first trying a new style. However, their use is planned so that pupils become independent.

RECOMMENDATION 7
Feedback

	Ineffective	Intermediate	Exemplary
Finding out what pupils understand	Teachers only find out what pupils understand occasionally. This is done mostly through summative assessment.	Teachers find out what pupils understand often and use this to inform their teaching. They know about a range of pedagogies to do this, but there is still a reliance on tests and practice questions.	Teachers are regularly finding out what pupils understand and use this to inform their teaching. They use a range of strategies, including low stakes assessments, discussion and peer- and self-assessment.
Using feedback to develop successful learners	Feedback does not focus on areas that will help pupils develop as learners and can be limited to praise.	Feedback on the task is clear and pupils are provided with information about how to improve on the specific task.	As well as feedback on the task, pupils are provided with information about how to improve on tasks of this type, so they can apply the feedback to other tasks. Pupils are also given feedback on their self-regulation and how to manage their learning.
Providing feedback that shows pupils how to improve	Pupils are only provided with marks (e.g., 8/10) or grades.	Pupils are provided with comments on how to improve in the future. This is done as written comments at the individual pupil level, which can be time consuming.	Pupils are provided with comments on how to improve in the future. Teachers understand a range of ways to do this, including orally to individuals or groups of pupils, or as a whole class for common errors.
Encouraging pupils to respond to feedback	Time is not provided for pupils to respond to feedback and pupils may not even fully look at the feedback provided.	Time is created in lessons or as homework to allow pupils to respond to feedback. How to respond is not always clear.	Time is created in lessons or as homework to allow pupils to respond to feedback. There are specific feedback tasks for pupils to respond to and there is a clear understanding between teacher and pupil as to the reason for, and outcome of the feedback task.