Bright Byte – The Fertile Question

1. The Fertile Question - What is it?

"Most people teach Biology by starting with the Molecule! This is exactly the wrong way to go. No one cares about the molecule. I don't care about the molecule. Unless I have a reason to care – that is, a problem that I am working on that requires understanding molecules to address it."

E.O. Wilson, Professor of Biology, Harvard University.

- Planning using Fertile Questions prevents the curriculum from becoming a series of isolated 'bore holes' or bits of information taught but not connected. It ensures students develop a meaningful and useable framework for each subject.
- Fertile Questions allow students to replicate the thoughts and actions of experts within that field. They create opportunities for students to see how knowledge has been created and how it is often contested whilst enabling them to apply knowledge to solving meaningful problems.
- Fertile Questions are naturally engaging - questions demand answers and problems, solutions. They do not focus on 'learning' snippets of information but on turning information into knowledge through applying it to a problem and testing how far it resolves that problem or tension.
- An approach based around a Fertile Question engages pupils and helps them to see the links between concepts and knowledge. It also goes beyond traditional models and instead promotes the idea that the enquiry is a journey that helps pupils to think historically, think scientifically, think geographically, think mathematically.
- The approach addresses the importance of balancing students' knowledge of facts against their understanding of concepts. In history they are learning about change and cause not just dates and events. It helps teachers transform straightforward science experiments into a true understanding of scientific principles in the way that a Scientist at CERN might apply them. In maths it balances the quest for absolutes with the need for multiple approaches.
- Fertile questions model the kind of thinking and intellectual habits we want from the students, and make it much safer for them to ask questions and take risks.
- A Fertile Question is a planning device for knitting together a sequence of lessons, so that all of the learning activities – teacher exposition, narrative, source-work, role-play, plenary – all move toward the resolution of an interesting and meaningful *historical/scientific/mathematical/RE* problem by means of a substantial motivating activity at the end.
- Fertile questions are helpful because they put the teacher and the student on the same intellectual plane. *'OK class, I genuinely don't know the answer to this question, but over the next six weeks we are going to puzzle it out together; maybe we should look at this, maybe that, but I'm going to need your help and your ideas to do it' (or something like that)*. They are an equalising force - this makes it much easier to model the kind of thinking and intellectual habits we want from the students, and much safer for them to ask questions and take risks.

2. Designing a Fertile Question – a '6 week' planning framework

The key to designing a good Fertile Question is to ensure that it is connected to both the students' current thinking **and** the desired kind of thinking – that of expert practitioners. Just as with a good lesson plan, it starts with what the students can currently do and explores what they need to be able to do next – framed as a problem to be solved. Scardamalia is clear why it is much more powerful to use a problem as the focus of a Fertile Question.

"Although problems are often expressed as questions, we have found that pursuing solutions to problems rather than answers to questions best encourages knowledge building. Answers have a certain finality to them, whereas problem solutions are generally continually improvable. Whereas comparing answers to questions puts students into the belief mode, solutions to problems, including solutions to knowledge problems, can be carried out in design mode—judging what different solutions do and do not accomplish, what new problems a solution raises and what problems need to be solved in order to progress in solving the main problem. Knowledge Building pedagogy differs from Problem-Based Learning in that the preferred problems are ones of considerable generality."[1]

3. The 4 principles for structuring a route through the Fertile Question.[2]

1. Start with a BIG, essential question that is debated in the world and is used by practitioners of the discipline. In other words a question that a professional mathematician or historian might ask before venturing into the unknown for answers or a real-world engineering issue that needs resolving.

2. It is essential that the question is framed within the concept it is focused on. For example a Fertile Question about evidence will revolve around a *'How do we know'* type question or a Fertile Question about Perspective will revolve around *'developing multiple perspectives on the problem presented.'*

3. Identify a concluding activity that requires a constructed response to the question (a *performance of understanding*) that will create a tangible product that solves the problem posed by the question.

4. Plan backwards from the end product by deciding what activities will develop the conceptual understandings and abilities essential to address the question and create a meaningful response to it. What needs to happen in each phase to allow for resolution of the problem?

4. Curriculum design and the '6 week' cycle – The teaching and learning cycle.

The Teaching and Learning cycle is a way of ensuring that every Fertile Question has an impact on progress and attainment. The cycle forms the over-arching scaffold for every lesson and enquiry (Fertile Question). The cycle works by posing 7 key questions that enshrine the construction of each enquiry. It is the simplest and most effective way of enshrining the medium-term planning process into a manageable and accountable model for all teachers.

These questions provide the rigidity of ensuring that the needs of the curriculum are met whilst being loose enough to allow for creativity and freedom in the planning and delivery from both teacher and learner.

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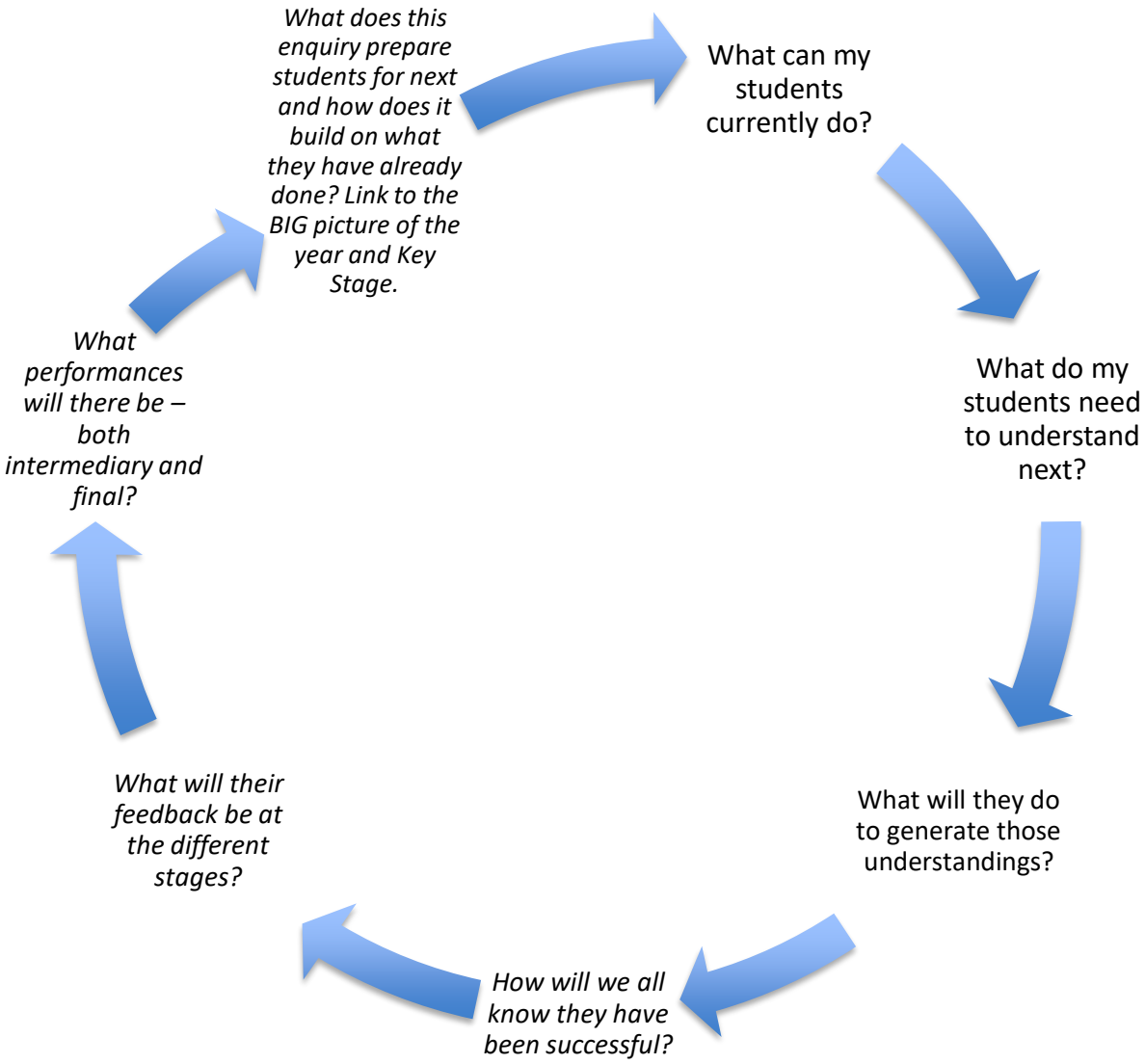
[1] Scardamalia, M. (2002). 'Collective cognitive responsibility for the advancement of knowledge. 'In B. Smith (Eds.), *Liberal education in a knowledge society.*

[2] Adapted from Smith, M and Wilhelm, J. *Going with the flow.* Heinemann 2006.

When you are writing a medium term plan start from these very simple questions:



5. The 8 stages of the Fertile Question:[3]

One of the reasons why Fertile Questions provide such leverage is because they emphasise the aspects of learning that make the most difference to student progress. The main focus is on developing student meta-cognition by constantly providing opportunities for reflection and discussion about 'how' as well as 'what', and on providing opportunities for a constant feedback cycle to be built in to the process. The focus of this feedback is always against the criteria outlined at the beginning of the enquiry, and focuses on the 3 key factors: *Where am I going, how am I doing, where to next?*

Once you have created your Fertile Question, you need to follow the 8 stages below:

1. Introduce the new Fertile Question – engage and motivate pupils, discover what they already know and check out their existing preconceptions. Outline and focus on the concept that frames the question and plan to build on their current thinking. Make this

[3] Lefstein, A. *Design heuristics for a community of thinking.* 2003.

known to the pupils and set clear outcomes and challenging goals = acceleration happens when expectations are high. You can activate Undergraduate level thinking in Y8 students by creating a Fertile Question that creates a junior version of an expert problem.

2. Allow pupils to decide what research question(s) they might like to formulate that answers the Fertile Question. This does not always have to be co-constructed and can be teacher set. This stage enables meta-cognition by allowing students to work out where they are and what they need to do next. This stage needs to be carefully planned for to allow for a reduction in scaffolding over time. This stage also consists of direct instruction – giving students the fingertip knowledge they need to solve the problem = moving from acquisition to application.

3. Start the process of Inquiry with a focus on dialogue not monologue– *what small questions do we need to answer to formulate a response to the BIG question; can we divide the BIG question up; what happens if we disagree; where might we go for information; what will we do if we get stuck; how will we know if we are on the right track; how much information do we need; how do we turn the information into knowledge; what language is essential to answering the question; how are we going to display our thinking; what are the success criteria; who is the intended audience, what is the purpose of this piece of learning?* Use of strategies like reciprocal teaching and Home and Expert groups to enable meaningful dialogue to occur.

4. Come back as a whole class to discuss findings so far and any problems that have arisen. Use teacher and peer review to critique current thinking and plan where to go next to ensure we solve the problem posed by the question.

5. Create an initial (draft) response to the question in groups or individually – tentative answers and provocative feedback to encourage deeper reflection. (Oral rehearsal) Use this stage to model and deconstruct the language required to replicate 'expertise.'

6. Peer review and re-drafting of first draft in light of feedback and moving from everyday to more formal language.

7. Group/individual concluding performance of the solution to the problem. Use or real (peer, teacher) or virtual (ICT) audience to give the response meaning and purpose.

8. Class concluding performance and feedback/review – *can we settle on one final answer, what does this prepare us to do next?*

6. What does a good Performance of Understanding look like?

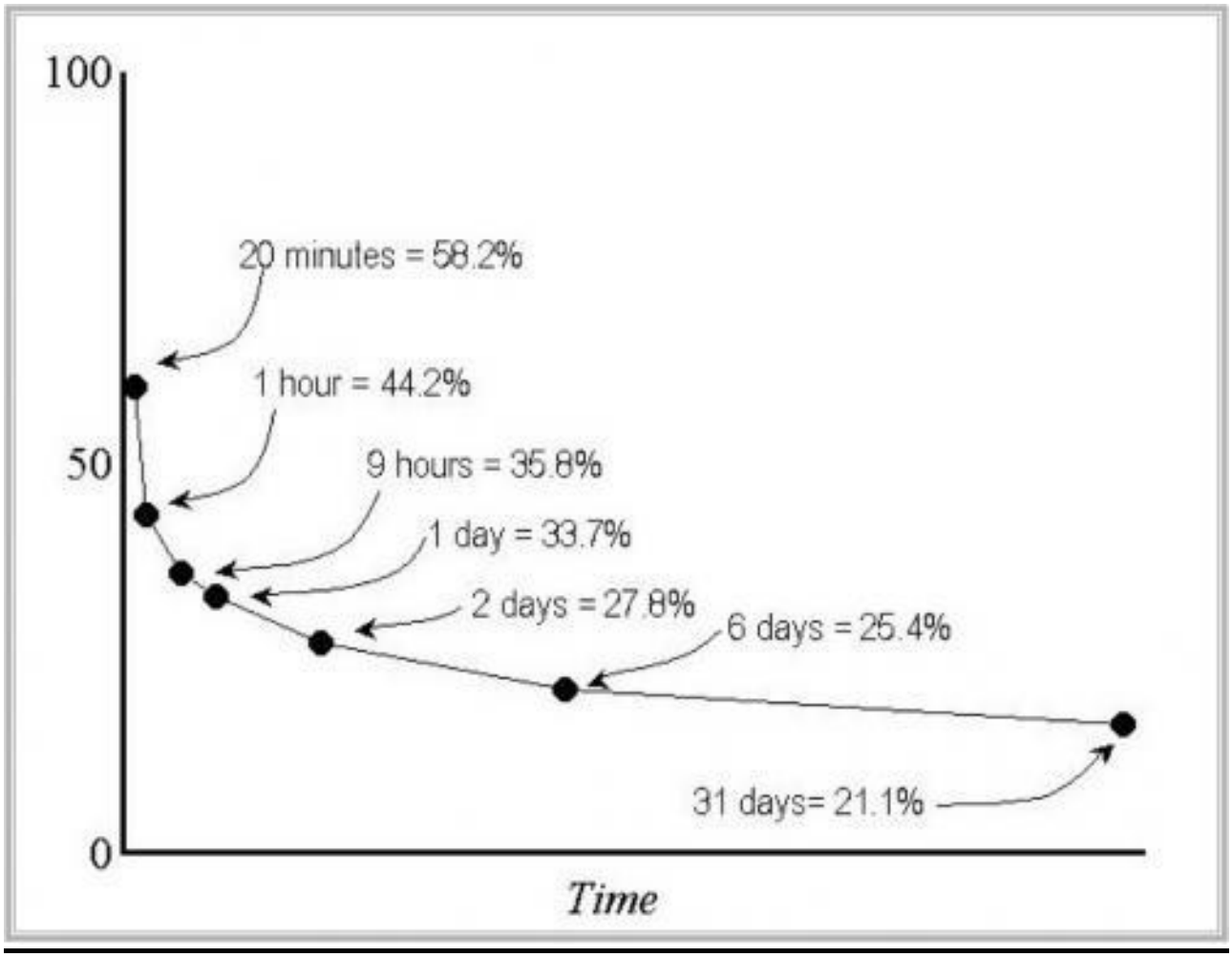
Fertile Questions need outcomes – concrete end-points where the students demonstrate what they have learnt. We call these 'performances of understanding'. If understanding something is being able to think and act flexibly with it we need to design approaches to assessment that allow for this to happen – applying their learning to an unseen problem or case. The key word here is *performance;* it must require the students to do something – preferably something new. So, the Performance of Understanding must be more than recital or re-wording. It must require students to be able to demonstrate that they can use and apply, not replicate. It should require them to (amongst other things and not all at the same time):

- Synthesise
- Predict

- Critique
- Construct/Create something new
- Question
- Interpret

It is important that the culminating piece of work is something you can *see, hear or read*. It is equally crucial that not all Humanities questions finish with an essay and all Maths questions finish with some questions to answer! How can we assess understanding and thinking if it is a representation of the work and thinking of the teacher? Instead the role of the teacher throughout the different stages of a Fertile Question is a changing one.

7. Why Fertile Questions?



[4]

The graph above is a model of the Ebbinghaus Forgetting curve. The graph displays what happens to information we have received over a period of 31 days. As you can see most of the information is lost

[4] Image initially from http://www.elearningcouncil.com/content/overcoming-ebbinghaus-curve-how-soon-we-forget

unless it is revisited and used in multiple contexts. This idea will be revisited later on in the reading section of the handbook.

Fertile Questions are a way of overcoming this curve by forcing students to constantly revisit prior learning and use what they have learnt previously to help them answer other smaller lesson questions, which are building toward the resolution of the BIG Fertile Question.

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8. Journey through the fertile question.

Introduce the fertile question and the scope of the enquiry. Use Fertile Question as a hook - to engage and intrigue. Make links back to previous learning and forward to future learning.

Check out pre-conceptions - what pupils currently think about the core concepts and what the disciplinary rules are - and give the BIG picture and purpose of this piece of learning.

Development of research questions - the small questions that answer the BIG question - either pupil or teacher led. Use this stage to further clarify learning intentions. Each small question becomes a lesson.

Start the enquiry process - using talk-based activities to elicit evidence of learning. Use talk as process to discuss current understandings. Co-construct success criteria. Role of teacher to focus on pupil miscues and provide constant feedback as pupils start to devise answers.

Use learners as a resource for each other - pupils decide how they can best display learning = what will be their concluding performance, where will they go for information/help/feedback?

Come back as a whole class to discuss findings and review learning so far - using talk as performance before moving into writing at later stage.

Have we answered the question? What else do we need to do?

Peer review of talk as performance and re-drafting in light of feedback.

Does it solve the problem?

Why have they said what they said?

Does their evidence support their judgement?

Joint construction of text - oral or written. Use of provocative feedback to deepen thinking and challenge.

Group or individual concluding performance - either using real (teacher or peers) or virtual (ICT) audience to give task meaning.

Performances judged against success criteria. Feedback and review.

How might this new knowledge be applied in different situations?

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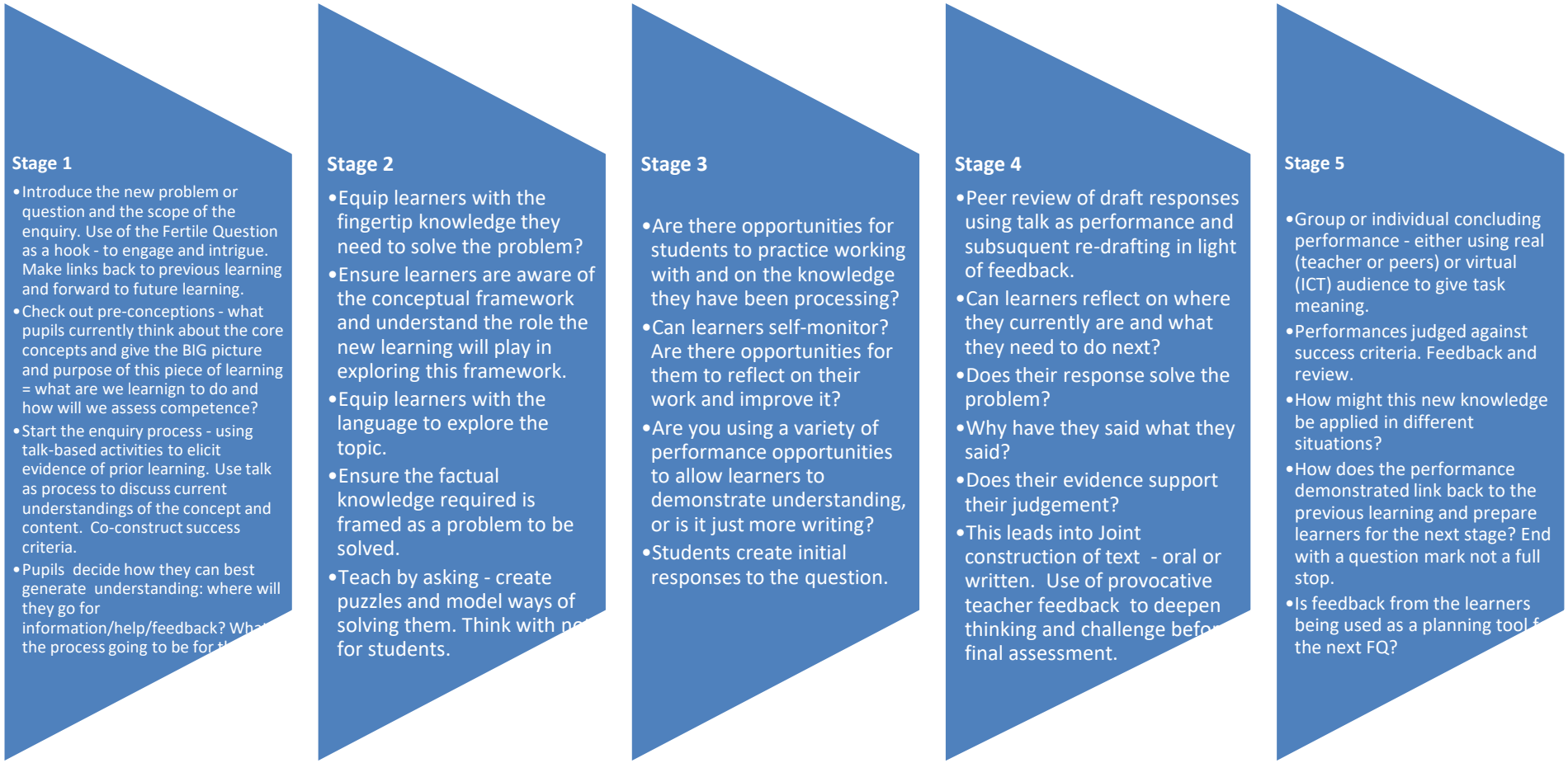
9. A 5 stage sequence through a Fertile Question using the principles of the BTT approach.

By following this pathway you will find that your students not only learn more 'content' but that they can use it to solve unseen problems – the true test of understanding.



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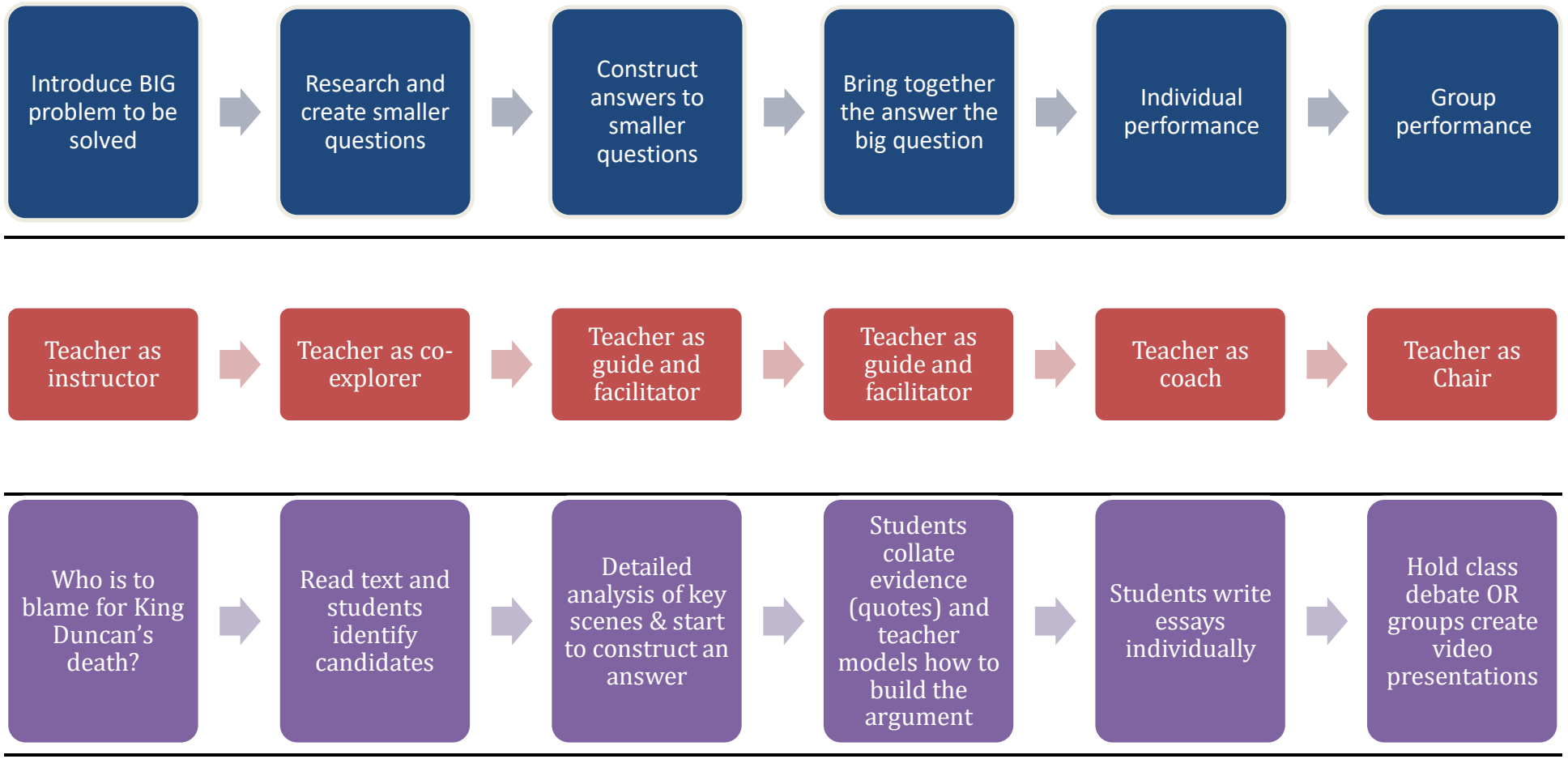
The different roles of the teacher at different points during a Fertile Question (with an example from GCSE English Macbeth)



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10. Teaching activities to build into Fertile Questions

TYPES OF COGNITION (thinking)	APPLY	ANALYSE	EVALUATE	CREATE	PRESENT
TYPES OF TEACHING ACTIVITIES (doing)	• Sketch • Manipulate • Experiment • Report • Record • Classify • Draw comparison • Simulate	• Classify • Categorise • Compare • Contrast • Diagram • Identify characteristics	• Judge • Discuss • Debate • Editorial • Rank • Consider	• Combine • Invent • Estimate • Predict • Design • Imagine • Speculate	• Observe • Identify • Listen • Sort/sequence • Match • Discuss • Restate
TYPES OF KNOWLEDGE OUTCOME (applying)	• To construct a model • To generalise • To give reasons to knowledge	• To analyse knowledge • To bring example, to invent metaphor, to make comparison • To explain knowledge • To find contradictions or tensions in knowledge	• To imply knowledge • To question knowledge • To expose the basic assumptions of knowledge.	• To synthesise knowledge • To formulate counter-knowledge • To generate new knowledge	• To express knowledge in your own words • To present knowledge in various ways • To present knowledge from different perspectives

				• To predict on the basis of knowledge	
TYPES OF END PRODUCT/ ASSESSMENT (creating & performing)	Model Map/mindmap Board game Diagram Graphic organiser	Graph Report Chart Essay	Report Review Advise Recommendation	Poem Pantomime News story Cartoon Song	Radio broadcast/ podcast Diagram Model Storyboard Role-play