INSIDE
MATRIX ACADEMY TRUST

SHARING PRACTICE
TEACHING & LEARNING

Magazine | Summer 2018

Inside This Issue:

Challenging The Most Able
Teaching For Retention
*Getting Your Pupils To **Speak** Out*

Inside Matrix Academy Trust

Starter Activities In Art

Elizabeth Morris
Bloxwich Academy

The starter activities shown are part of an ongoing series used to test prior knowledge before the main task is carried out. The tasks are differentiated to the ability of students using the Art department 'sticker coding'.

The activities allow students to experiment and practise with the particular technique/skill to be applied in the main activity and learning outcomes. After completion the teacher can visually assess if resources and the level of challenge need to be adjusted for individuals, this experimentation also boosts resilience and confidence with students and Elizabeth has found this particularly beneficial with SEN and Most Able students.

Inside Matrix Academy Trust

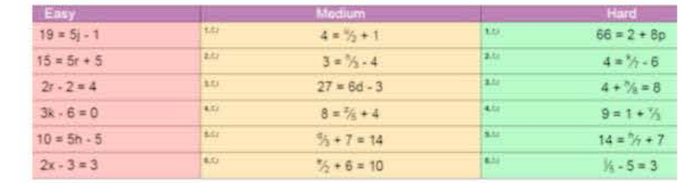
Stretching Pupils With Homework In Maths

Ben Bradley
Bloxwich Academy

- Pupils are given a compulsory piece of homework to complete each week and challenge homework (optional to yellow and red pupils).
- As shown in the image above pupils are placed in a sitting plan using the data to highlight high ability (green), middle ability (yellow) and lower ability (red).
- Using the tables you can form a competition with homework; a points system I use are as follows: more than half the questions correct = 5pts, all questions correct = 10pts, attempted challenge homework = 5pts and 20pts for all questions correct on challenge homework. The competition is finalised every half term and prizes are awarded.

Impact:

- During the use of this I have saw an increase in homework being returned.
- Positive outlook on homework and pupils increasingly asking about the due date of homework.
- Lower ability pupils wanting to attempt the challenge work as it helps there table with points.
- Most importantly, in the last assessment every pupils level apart from one increased; 1 sub level = 56%, 2 sub levels = 16%, 3 sub levels = 12% and 4 sub levels = 12%.

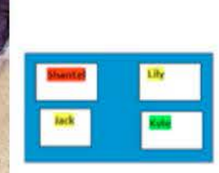


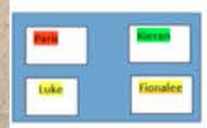
Challenge Homework

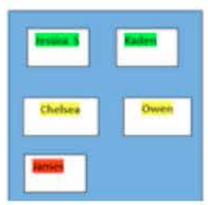
Remember to use one of two methods!

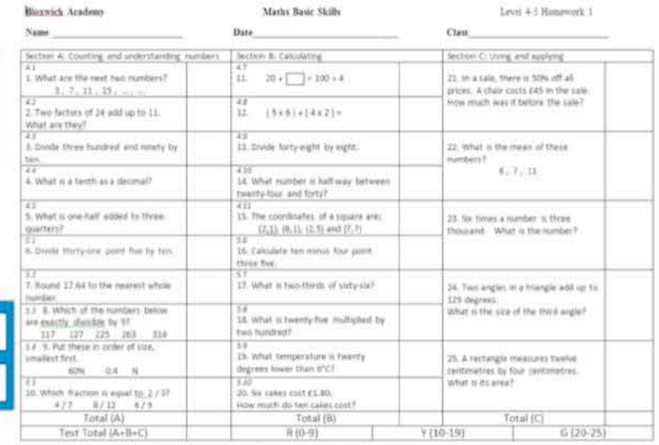
Easy	Medium	Hard
19 = 5j - 1	4 = ⅔ + 1	66 = 2 + 8p
15 = 5r + 5	3 = ⅓ - 4	4 = ⅔ - 6
2r - 2 = 4	27 = 6d - 3	4 + ⅝ = 8
3k - 6 = 0	8 = ⅝ + 4	9 = 1 + ⅓
10 = 5h - 5	⅔ + 7 = 14	14 = ⅔ + 7
2x - 3 = 3	½ + 6 = 10	⅛ - 5 = 3

Use a spare sheet of paper or the back for your method.









Bloxwich Academy — Maths Basic Skills — Level 4-5 Homework 1

Name _____ Date _____ Class _____

Section A: Counting and understanding numbers	Section B: Calculating	Section C: Using and applying
4.1 1. What are the next two numbers? 3 , 7 , 11 , 15 , ... , ...	4.7 11. 20 + □ = 100 + 4	21. In a sale, there is 50% off all prices. A chair costs £45 in the sale. How much was it before the sale?
4.2 2. Two factors of 24 add up to 11. What are they?	4.8 12. (5 x 6) + (4 x 2) =	
4.3 3. Divide three hundred and ninety by ten.	4.9 13. Divide forty-eight by eight.	22. What is the mean of these numbers? 6 , 7 , 11
4.4 4. What is a tenth as a decimal?	4.10 14. What number is half-way between twenty-four and forty?	
4.5 5. What is one-half added to three-quarters?	4.11 15. The coordinates of a square are; (2,1); (6,1); (2,5) and (?,?)	23. Six times a number is three thousand. What is the number?
5.1 6. Divide forty-one point five by ten.	5.6 16. Calculate ten minus four point three five.	
5.2 7. Round 17.64 to the nearest whole number.	5.7 17. What is two-thirds of sixty-six?	24. Two angles in a triangle add up to 125 degrees. What is the size of the third angle?
5.3 8. Which of the numbers below are exactly divisible by 9? 117 127 225 263 318	5.8 18. What is twenty-five multiplied by two hundred?	
5.4 9. Put these in order of size, smallest first. 60% 0.4 ⅘	5.9 19. What temperature is twenty degrees lower than 6°C?	25. A rectangle measures twelve centimetres by four centimetres. What is its area?
5.5 10. Which fraction is equal to 2 / 3? 4 / 7 8 / 12 6 / 9	5.10 20. Six cakes cost £1.80. How much do ten cakes cost?	
Total (A)	Total (B)	Total (C)
Test Total (A+B+C)	R (0-9) Y (10-19) G (20-25)	

Competition	Half term 2	Half term 3	Half term 5	Half Term 6
Table 1	45	65		
Table 2	65	20		
Table 3	85	30		
Table 4	90	45		
Table 5	60	20		
Table 6	95	45		

Attempted Challenge	5pts
All questions correct	10pts
Over half questions correct	5pts

Inside Matrix Academy Trust | Flipped Learning Model

Adam Rathbone
Barr Beacon School

This is the our new *flipped learning Model.* We are trying to build on from the work we did last year. As the flowchart shows pupils are given the topic criteria and possible keywords at the start of the unit and told that this is what their notes need to include. The use lesson time and homework videos to build up the knowledge and record it in their topic notes document, must be digital for ease and redrafting. At the end of a topic pupils hand in notes which we mark (see the feedback booklet) and then if improvements are needed notes need to be improved.

Student Learning Record (SLR) Booklet

Page for each topic in the course and all the criteria for each topic.

Space to feedback how well you do on each topic.

Flipped Learning

Videos/ text/ websites

that allow you to learn in your time.

SLR Notes

Digital notes/ diagrams/ code

that you keep and add to when you learn new things from lessons and flipped learning.

Lessons

Check your notes and understanding of flipped learning using exam styles questions.

Set next flipped learning task.

Assessments

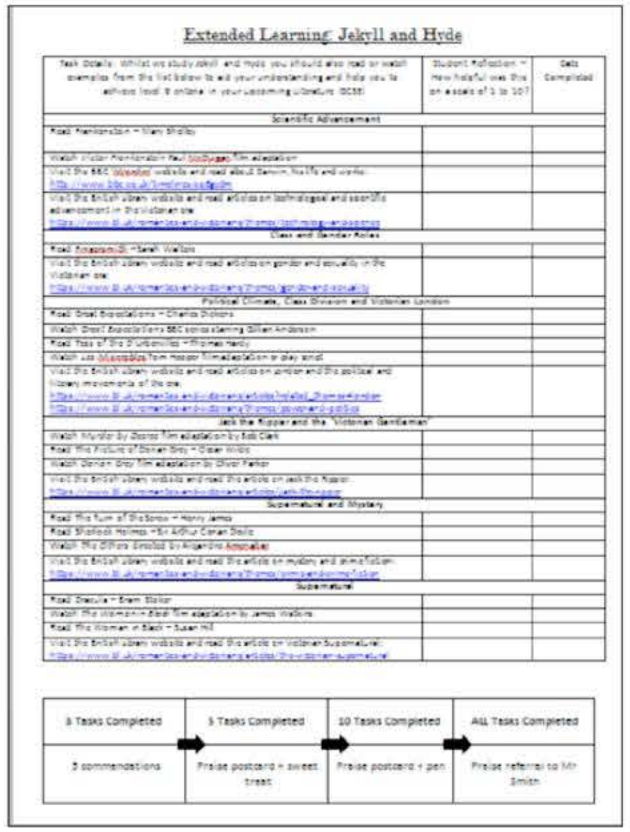
Topic tests made up of exam style questions to see how well you understand the topic.

Results from test and quality of SLR Notes recorded in **SLR Booklet**

Inside Matrix Academy Trust | Challenging The Most Able In English

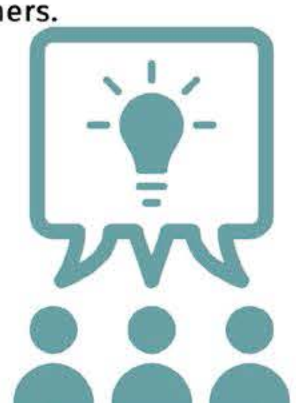
Katie Smith
Etone College

During the Autumn term at Etone, the English department piloted a new strategy to address a number of areas on our Department Development Plan: challenging the most able, wider reading and developing a love of learning. High prior attainers in years 10 and 11 were issued with an 'Extended Learning Challenge' linked to the topic they were studying in class. This was created as a list of wider reading and extended work challenges on one sheet of A4 paper (see image). Students were introduced to the tasks by their class teacher. They had one copy to glue into exercise books as a record of completed challenges and a second copy to take away with them for reference. They were challenged to complete as many of the tasks as they could – with different rewards being available for completion of different numbers of challenges. Students were encouraged to be 'self-managing' and independent in their completion of these tasks and had it explained to them that in the new GCSE exams the achievement of grade 9 was closely linked to individual extended knowledge – students developing ideas from their own wider reading rather than from what they'd been taught in class.



Over the course of the term, students worked at different rates and independently signed off challenges and received rewards. The class teachers involved had a clear record of student participation and noticed that students were able to contribute more confidently to discussion in class. Miss Kavanagh said of her Y11 top set "Students were able to talk far more knowledgeable about the text and context and their writing began to reflect level 9 characteristics." During the Y10 mock exams the same group had achieved only grades 5 and 6. Students who had previously been disengaged were able to re-engage with the subject because their wider learning was within their own control. Miss Williamson said of her year 10 group "high prior attainers became really involved and self-motivating whilst others in the group responded well to the 3 task challenge."

During the Sixth form open evening, we saw evidence of the impact this strategy had on 'love of learning' because many of the group showed an interest in studying Literature at A Level and were able to make connections between texts on the A Level specification and their current wider reading. Year 11 student Keely Gardner engaged so well with the task that she keenly discussed her wider reading and plans to approach other tasks during lunch breaks. Year 10 students needed more direction but responded well when challenges were set as 'Flip Learning' tasks. This is definitely a strategy that has worked for us; we will continue to develop it over the course of this year with a view to adapting it to engage boys as fully as it has high prior attainers.



Inside Matrix Academy Trust | What Does This Look Like In A Classroom?

Dr. Alison Cook
Barr Beacon School

(1) Something to add to your reading list

What Does This Look Like in the Classroom?
Bridging the Gap between Research and Practice

Carl Hendrick and Robin Macpherson
John Catt Educational Ltd (2017)
ISBN: 978 1 1911382379

Why write a teaching tip, I thought, when you can have an entire book full of great ideas!

If you are interested in how educational research can be applied to classroom practice, then this book is for you. Whether you are a fresh and enthusiastic student teacher or an old cynic like me, you will get something useful out of reading this.

As David Laws says in the foreword,

"too much that happens in education is based on hunch, assumption and ideology"

"What Does This Look Like in the Classroom" is a collection of ten chapters, each focusing on one aspect of education. Each chapter starts with a short summary of the chapter's key points then features interviews with two expert participants per chapter where they answer exactly the sorts of questions teachers are likely to want to ask about bringing ideas from educational research into everyday practice. In addition, for those who find their interest caught, there are footnotes and a suggested reading list.

The chapters focus on assessment, marking and feedback; behaviour; literacy; SEND; motivation; memory and recall; classroom talk and questioning; learning myths; technology; and independent learning.

This book contains readable and reflective criticism of current educational initiatives. It takes aim and fires at long-held, cherished educational beliefs that have little or no evidence to back them up – and you might find some of those surprising. Instead, it offers immediate and simple practical advice on strategies that could have a positive impact on how effectively students learn.

(2) http://www.learningscientists.org/

This website is an amazing resource for when you want to get your pupils to think about revision techniques.
There are downloadable resources for spaced practice, retrieval practice and a few other strategies for effective learning.

Inside Matrix Academy Trust | Getting Your Pupils To *Speak* Out

V Lopez
Etone College

One of the biggest challenges of the new GCSE for languages is getting our pupils to speak out loud and improvise. But of course new challenges are what make us think and adapt our practice.

Language exam requirements have changed, and so we have to change the way that we teach.
For example the new exams require pupils to give spontaneous descriptions of an unknown picture. When I first started practicing this task with students I was really disappointed that after weeks of teaching my students couldn't articulate a word. What was I doing wrong?

There was clearly a gap between knowing the vocabulary and grammar and having the skill and confidence to 'improvise' in the language.

To teach this I had to devise exercises that would enable them to find a structure to express their thoughts. This is something we do subconsciously in our native tongue but which requires practise in a learned language.

Simple confidence building tasks then began to be the focus of the teaching.
Say what you see. Building simple descriptive sentences using adjectives
Describe what is happening. Translating actions and feelings into words
What is the image implying? Take it the next level - create a story from the scene, and give your own thoughts

Using these simple steps and applying the learned sentence structures for each one, pupils now felt equipped with trusted techniques that they could employ in any scenario.

CPD Exceptional Progress

V Lopez & R Ratcliffe
Etone College

When our line manager asked us to contribute to an Etone CPD session on 'Exceptional progress' we were very happy! (as it must mean we are doing something right!). He said *"Your pupils achieve outstanding results, what do you do to achieve this?"*

That question made us think... what do we do? Well we teach... Most of us get into our classroom routines and school relies on our work ethic and professionalism to make things happen. Each classroom is a little kingdom and a natural assumption is that what we do is the same as everyone else does. We don't have time to start observing other colleagues teach and to watch 'our' pupil's behaviour when in another classroom.

So what, if anything, makes our teaching different? In order to answer this question we turned to our beloved pupils, after all they get to see many different teachers every week, so better to say what the differences are. We went off on a quest to find answers from a range of pupils that knew us and who covered all key stages and abilities.
Although they used different words and expressions there was a commonality in their answers:

- Routine and consistency was the most commonly cited characteristic. Pupils said that they valued having set routines and knowing what is expected of them.
- Differentiated work was also mentioned, pupils appreciated having different tasks and activities that they felt were tailored to them and their ability. The most able felt challenged and the lower ability groups felt that they could still participate in a meaningful way. Being over stretched or bored were things that really frustrated them in other lessons and led to poor behaviour.
- Understanding 'where they are' with their learning. Understanding the size and scope of the overall topic on which they are working, and not just the individual lesson objectives. This allows them to independently take their learning further (as they know what is coming next) and also helps give them context and understanding for each individual lessons.

To us this really highlights the importance of planning for the medium term, by topic or unit and not by lesson. Sharing this syllabus planning with the pupils helps them as well as helping you.

This seems especially true in KS4 and KS5 where pupils value knowing their exam specification and being given the chance to revise independently and to look for additional learning resources - beyond those used in class. This way you are opening up the world of learning to pupils – not restricting them to your materials.

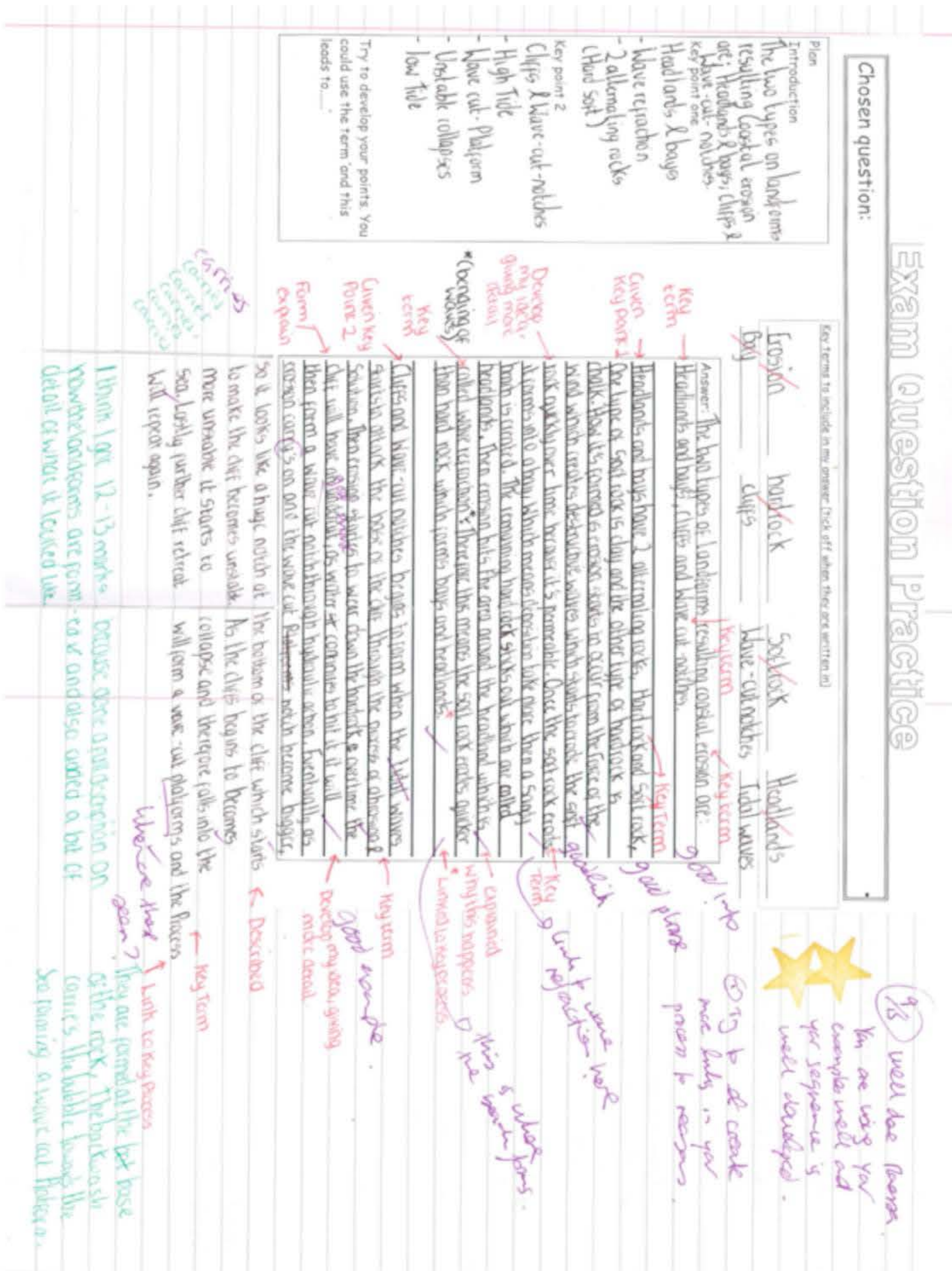
With this in mind we decided to focus the second of our CPD on exam preparation through mark schemes and creating approaches to answering exams questions

We looked into the different uses of mark schemes and how they can be used to secure confidence in the exams and improved exam skill.

The benefits of using mark schemes are that the students gain a greater understanding of the expectations of exam questions and gain an insight into what the examiners want to see and how it needs to be written. It can be beneficial to modify mark schemes so they are more pupil friendly but it is important that students are familiar with key terms and phrases in mark schemes so this shouldn't be done all of the time. The main benefits from using mark schemes come from varying the use and depth in applying it. It is beneficial to spend time early on going through line by line but students can lose independence in exam questions if they are over-reliant on using mark schemes. Students should regularly complete exam questions without access to the mark scheme so they are prepared for the situation they will face in an exam.

Slow writing can be an alternative way to use mark schemes and to approach exam questions through using metacognition to encourage students to plan and carefully consider the structure of exam questions. When using this it is important to give students a longer time limit so they can really think through their answers. By annotating as they write, students think through what they are doing and can actively amend their structure as they go.

Hopefully you have found this article useful (and enjoyable!) and you can find some ideas here to incorporate into your everyday teaching. We are happy to talk through other ideas and answer any questions you may have in person or by email. Happy teaching!



Inside Matrix Academy Trust | Taking Ownership Over Their Progression

Emily Goodman
Barr Beacon School

Something that has worked particularly well with Year 9 Literature students is them taking some ownership over their progression and marking in poetry. Each lesson they are given a variation of the GCSE criteria which they must work towards, after each PETER paragraph/long answer they peer assess before I look at the work

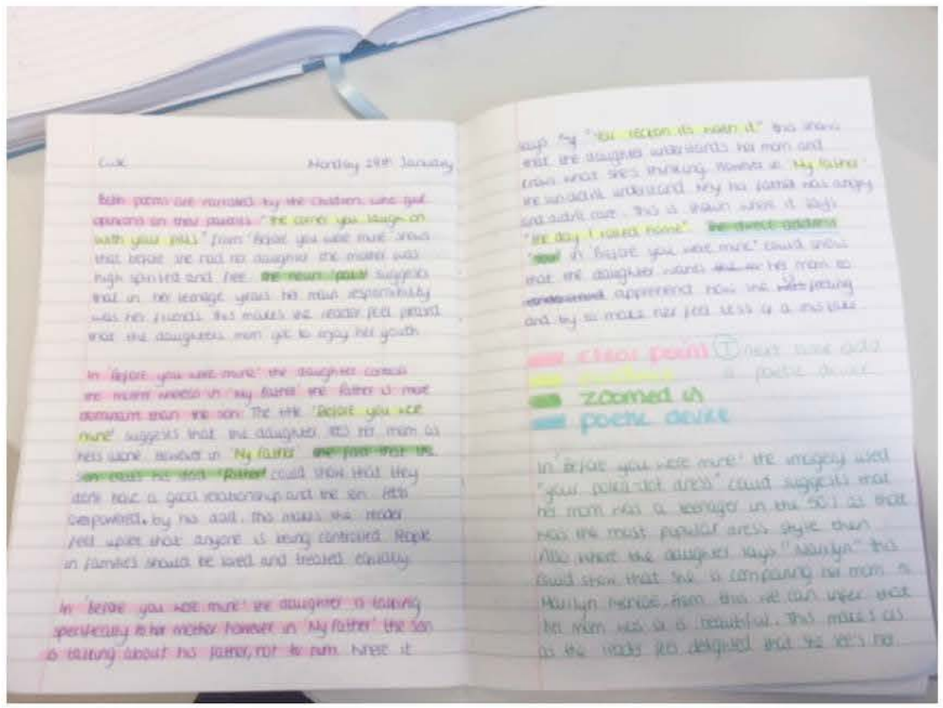
SMILE

Compare Simon Armitage's poem to one other we have looked at.

Success Criteria

- ✓A ***clear point*** which relates directly to the question.
- ✓Relevant use of ***evidence***.
- ✓***Zoomed*** in on a key word/phrase and explored the relevance/meaning.
- ✓Explored the ***poetic devices*** (terminology) used.

Using the bullet points given they highlight their work in four different colours and then give a target based on what they aren't seeing a lot of.



Pupils have responded well to this type of task, it has allowed them to take some ownership over target setting and getting to ensure they are making progress within the scheme of work.

Inside Matrix Academy Trust | Short & Sweet Extended Progress

Claire Eardley
Barr Beacon School

An increase in the vast amount of knowledge and skills students are expected to remember and master sometimes leads to them feeling demotivated as they cannot visualise the progress made.

The importance of chunking information has been used effectively for many years and is now supporting students within the Science curriculum. The term "chunking" in science is a method for learning complex scientific concepts that have multiple parts. Because many scientific ideas, terms and methodologies are long and complicated, students can apply the principle of chunking to learn and remember the information. Chunking is breaking down large portions of information into smaller pieces, so they can be analyzed, processed and retained.

A typical lesson within my classroom that uses chunking effectively would include a five-minute introduction to the new concept. The concept is explained in simple student friendly terminology and always includes a worked example or link to the student's everyday life. This is vitally important, as it will lead to students forming effective notes and memory points to support them in the next portion of the lesson.

After a new concept has been introduced, and new knowledge has been created, the students must begin to apply the new skill to students led activities. I have a set of up to five laminated cards labeled task A to E, which also specify the grade level of the task. Students have a 15-minute timer displayed in the interactive whiteboard and complete one to five tasks based on their progress level. The laminated cards are placed with the activities around the room and the students choose which activity to complete. The tasks are short and build in complexity (see example below)

Lesson example – Protein synthesis. – Transcription (we would then cover translation in the second half of the lesson)

Task A – Grade 3 - Label the diagram using the 6 key terms.
Task B – Grade 4 – Extracting information from key text including 5 questions.
Task C – Grade 5 – Medium demand short answer past exam question
Task D – Grade 6-7 – High demand extended answer exam question

This style of lesson allows students to take control of their progress and can support them in building their confidence. If they are unsure the mark schemes for all tasks are provided. Using a mark scheme or model answer to understand the question is as powerful as answering if from scratch when a student is lacking in confidence within your subject. I store a library of textbooks, revision guides and Science encyclopaedias within my classroom so that the students can engage in problem solving and active learning to progress through the tasks.

Every task a student completes is rewarded with verbal praise from myself and rewards following the school procedure.

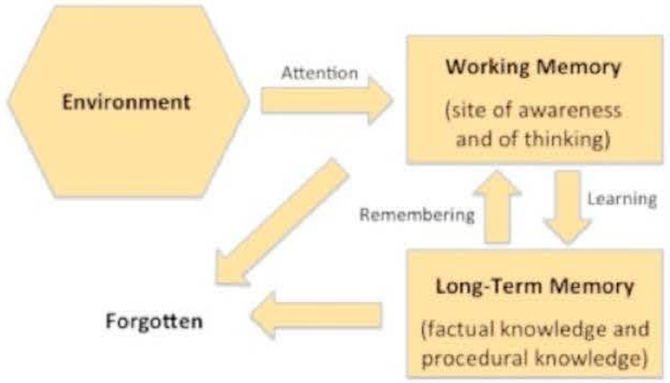
After 15 minutes we may introduce a chunk of new learning or work as a class towards producing model answers. Observing the students completing the short tasks enables me to clearly see any whole group misconceptions and address them where required. If the 15 minutes is up and I can see the students are working through the tasks we may as a class decide to extend the time allowed.

I have used this model for a number of years and have found it effective in supporting the progress of students from year 7 up to year 13. Giving students a choice in their learning will build engagement and you will be surprised how many of your students complete the stretch and challenge activities when their progress is not limited.

Inside Matrix Academy Trust | Teaching For Retention

Charlotte Russell
Etone College

As part of the CPD programme at Etone College in the Autumn term, both Graham Hodgson and myself were given the opportunity to research and present an issue that is becoming increasingly relevant, teaching for retention. Recent curriculum changes have led to new challenges for practitioners, particularly with the rise in linear qualifications and qualifications in which coursework carries less weight. In light of these reforms, teachers now face the prospect of training students to retain two or three years' worth of knowledge in preparation for challenging examinations. What role do teaching staff have in promoting retention? How can we support students in learning and retrieval? How might long term planning and assessment frameworks be used to maximise the retention of core knowledge and skills?

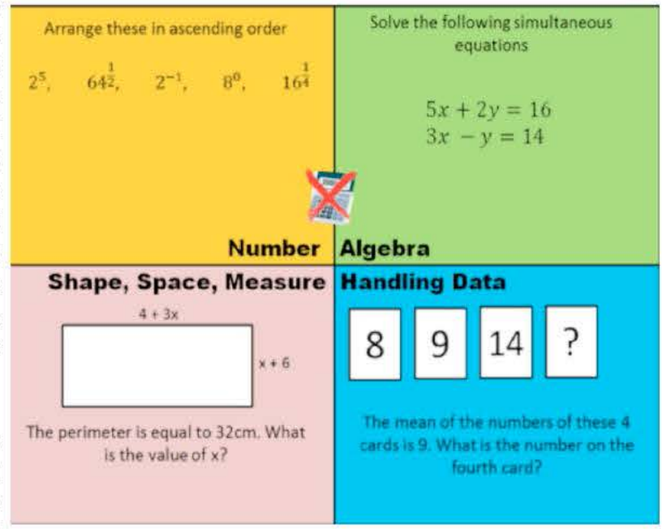


As a Psychology teacher, I was interested in the theory behind how humans remember information. There have been many influential models of memory, but which ones were most applicable to the context of education? Daniel Willingham argues that teachers would be better able to help students if they understood the psychology of long term memory and 'working memory'. Willingham proposed a model of working memory which highlights clearly the areas that we could consider as teachers. During the confines of a single lesson we tend to teach to students' working memory. This, according to Willingham, is a temporary short term store with an incredibly limited capacity (around four chunks of information). We don't tend to teach in such a way that facilitates the transferral of this information to long term memory, a vast, unlimited memory store! Once information hits long term memory, it lasts for an infinite amount of time, until we seek to retrieve it. Perhaps this is the ultimate goal for teachers, facilitating the transferral of information to our students' long term memory.

One of the barriers which prevents teachers from targeting the long term memory store is the fact that working memory can only process around four chunks of information. This seems such a limited amount of learning if you consider the number of new pieces of information students' encounter over a typical five period day. This forms the basis of Cognitive Load Theory which suggests that students will find it difficult to transfer information to long term memory if we overload their working memory. Sweller (1988) argues if we increase cognitive load students find it more difficult to pay attention to, rehearse and retain the information. In line with this claim, Sweller proposed a series of simple strategies for practitioners, to reduce cognitive load in the classroom and as a result maximise the chances of long term memory transferral. Many of these strategies are things we address automatically. They include:

1) Limit multi step instructions.
2) Try not to present lists of unconnected facts.
3) Avoid applying a 'just learned' concept onto a brand new piece of material.
4) Chunk information down into manageable pieces.
5) Embed opportunities for **retrieval practice.**

Having read around the literature on retention, it seems that the last strategy, embedding 'retrieval practice' is one of the most common ways to promote long term retention. Retrieval practice is giving students the opportunity to retrieve information stored in their long term memories. Research has shown that increased testing can lead to better recall and retention, known as 'The Testing Effect.' Some believe that teachers should consider interleaving (spaced) opportunities for retrieval practice regularly into schemes of work through strategies such as spontaneous lesson starters. Interleaving retrieval practice is a regular occurrence in Maths lessons at Etone. The image below is an example of random skills checks which are interleaved during various intervals as starter tasks throughout the year. This encourages students to put their skills into practise, applying them to unseen problems. In order to access the task, students need to recall the stages required to solve the problems, promoting spontaneous retrieval. Some research has been conducted into what constitutes an appropriate time interval between retrieval tasks. Findings suggest that increasing the time schedule between each retrieval practice in an expanding schedule (e.g. recall after 1 day, 1 week, 1 month), is most effective in promoting long term retention.



There are endless tasks which we as practitioners could give students to complete as retrieval practice. Starter tasks such as multiple choice quizzes, true or false or application tasks could all be utilised to promote retrieval. Equally, if retrieval practice does promote retention, this could have implications for schedules of assessment and long term planning. Students could even be set retrieval homework in which they test themselves on previously learned content using online platforms. Regardless of the way in which practitioners implement it, psychological models of memory all share the same belief that the more we rehearse, practise or attend to it, the more likely the retention.

Carbon Capture - Iceland

Ketan Patel
Barr Beacon School

1) Locking Earth's excess carbon dioxide away for millions of years by turning it into rock.

Iceland is widely touted as a leader in green energy, generating 100% of its electricity from renewable sources. It might come as a surprise, then, to hear that this sparsely populated country has a huge carbon dioxide emissions problem. This is because although Iceland's two electricity sources – hydropower and geothermal – are promoted as being clean, they still cause the emission of significant amounts of carbon dioxide and other gases.

A secondary issue is that Iceland produces a lot of electricity for industrial purposes, explains Eric Oelkers, professor of geochemistry at University College London. The availability of copious amounts of electricity at consistently low prices has attracted the global aluminium production industry to the country. The extraction of aluminium from ore is a very energy-hungry process. 'Iceland imports aluminium ore, smelts it and then exports the aluminium again,' Eric says

2) Volcano Power

Eric has been overseeing a novel initiative to reduce emissions at the country's largest geothermal power plant. Hellisheidi produces electricity and hot water from the Hengill central volcano, with a capacity of 300 MW of electricity and 120 MW thermal.

The initiative, CarbFix, is a carbon capture and storage (CCS) project with a twist. Conventionally, the carbon dioxide captured using CCS is stored underground in depleted oil and gas reservoirs or other locations where it is unlikely to leak back out again. However, Iceland's volcanic nature means it doesn't have any nicely sealed underground reservoirs suitable for long-term gas storage. Eric's team therefore needed to develop an alternative approach.

Instead, the team is injecting carbon dioxide captured at Hellisheidi into basalt, a reactive rock rich in divalent cations such as calcium and iron. Here it reacts to form the carbonate mineral calcite ($CaCO_3$). This locks the gas away for millions of years in an environmentally benign manor. 'The only solution there was for Iceland was to get the carbon dioxide to react with basalts to make carbonated rocks,' Eric explains. 'Once the carbon dioxide is mineralised it stays there forever: the average age of a carbonate rock in the crust is 200 million years old.'

The project started in 2006, and has been through many design and testing stages. In 2016, the team reported in Science surprising findings from its final pilot plant study at Hellisheidi. The carbon dioxide they had injected into the basalt had reacted to form rock in less than a year; it had been predicted this process would take many years.

But while the technology development has proceeded near perfectly, it hasn't been a smooth ride getting this far. 'There have been some twists and turns in the story,' Eric says. 'Over the years it became clear that there is no financial model to make carbon capture and storage work. Many of these projects globally started shutting down. It costs money to do and if no government was going to force people to do it, nobody would.'

The Icelandic government, however, was happy to fund the removal of a second hazardous gas from Hellisheidi's flue gases: hydrogen sulfide (H_2S). Unlike carbon dioxide, hydrogen sulfide has an immediate impact on the local population. 'It smells of rotten eggs,' Eric explains. 'Because of increasing energy production the levels of hydrogen sulfide were beginning to get too high in some parts of Iceland. What we did is expand the capture and storage of carbon dioxide to capture and store, simultaneously, hydrogen sulfide and carbon dioxide.' Hydrogen sulfide, when injected into basalt rocks, rapidly forms pyrite (FeS_2), also known as fool's gold. The hydrogen sulfide part of this project is called SulFix.

Since 2014, the CarbFix-SulFix project has been operating on a commercial scale. 'About two-thirds of the gases produced by the plant are currently injected and this will be upscaled to 100% within about a year,' Eric says. Without the capture technology, Hellisheidi emits about 40,000 tonnes of carbon dioxide and 12,000 tonnes of hydrogen sulfide each year. To put this in context, this is about 5% of the emissions that would come from a similarly-sized coal-powered plant.

3) The technology

The first generation of the CarbFix technology involved separating the carbon dioxide from the flue gases, dissolving it in water and then injecting it into basalt rock. Water reacts with carbon dioxide to form carbonic acid (H_2CO_3), which plays an important role in the mineralisation process. In the final pilot study reported in Science, the gas from the plant was also combined with extra carbon dioxide brought in from elsewhere, including some spiked with heavy carbon (carbon-13) to aid monitoring of the mineralisation process. (Samples are still routinely taken from wells to monitor the pH and geochemistry at the injection site.)

The request to capture and inject hydrogen sulfide from the flue gases as well allowed the process to be simplified. 'What we do now is take the exhaust gas from the power plant and put it through something called a sparger, which is a fancy name for a shower,' says Eric. 'Raining water on the exhaust causes the carbon dioxide and hydrogen sulfide to dissolve. We then take this pressurised water and inject it directly into the ground. It's very simple.' The process has been shown to work with both fresh and seawater.

Energy is the only major cost associated with the project once the system has been installed. 'Energy is used in the inner pressurisation of system used to dissolve the carbon dioxide and hydrogen sulfide in the gas,' Eric explains. But the amount of energy required is far less than for conventional CCS units that inject the gas into disused oil wells and the like. It has been estimated the CarbFix-SulFix process will use up approximately 0.2% for the power produced at Hellisheidi. This compares well to the 3 to 10% typically reported for conventional CCS units at coal- and gas-fired power plants. This equals significant cost savings. 'The cost of doing this is approximately $25 a tonne, compared to in the order of $60 to $120 a tonne with conventional technology,' says Eric.

The success of this mineralisation process opens the doors for the CarbFix-SulFix setup to be replicated at other power plants. 'Basalts are very abundant,' says Eric, both on land and under the sea. 'Pretty much all the ocean floors are basalts, which is an advantage because people don't seem to want carbon dioxide injected underneath their homes,' he adds. Ultimately, however, Eric believes that politics will determine whether the technology is eventually used elsewhere.

Meanwhile, in January 2017, his team started to develop their technology to capture carbon dioxide directly from the air. 'Less than half of the carbon dioxide that goes into the atmosphere comes from power plants. More than half comes from cars, jet planes, etc. We're going to have to air capture eventually,' he says. Again, this technology would be suitable for any site near basalts and with lots of water available. 'We're teaming up with an air capture company to do this on the coastline of Iceland.'

Directed activity related to text (DART)

In your class

(Ages 11–16)

Exam questions requiring a longer written response (6–8 marks) often present familiar chemistry in an unfamiliar context and require students to read text and extract key information. Much of the chemistry in this article is familiar to 14–16-year-old students, though the idea of carbon capture won't have been directly studied.

DART activities require pupils to engage with the text rather than just reading it passively. DARTs can be as simple as a set of questions related to a piece of text or a comprehension exercise. For older pupils, a focused task similar to the 6–8-mark examination questions is useful.

With activities like this, differentiation is important. Task 3a looks for advantages and disadvantages and is suitable for pupils who are beginning to develop this reading skill. Task 3b requires a higher level of analysis where pupils categorise phrases and summarise them.

Tasks

1. Read the whole article and underline unfamiliar words.

2. Once you have read the whole article once, reread the section headed 'The technology'.

3a. Using different coloured pens, highlight phrases in the article that state the advantages and disadvantages of the CarbFix method of carbon capture.

3b. The issues surrounding scientific developments can be categorised into the 'SEE' framework covering social, environmental and economic impacts. Use the information in the article to summarise the impact of carbon capture into these categories.

Examination questions are increasingly requiring literacy in addition to content. DART tasks are a really good way to improve literacy in your subject, regardless of age group and ability. The article or piece of text you wish to use can be as long or short as you wish. The article about Carbon Capture, I RAGP certain sections, but this isn't essential. The instructions are below. Feel free to contact me for more information on how to link this to examination questions.

Inside Matrix Academy Trust

Refresh, Recap and Relate - Differentiated Do Now task

Jess Williamson
Bloxwich Academy

- Differentiated starting points based on current targeted groups in the lesson.
- Use of 3R's to support AFL and stretch pupils to consider topics related to the content.
- **Refresh -** reinforce previous content taught- this could support and assess retention of knowledge. This helps as it is a constant drive to revisit different elements of taught content over the school year. Topics could range from areas covered at the beginning of the year.
- **Recap -** Assess content recently covered to check the level of understanding.
- **Relate –** Provide questions to allow pupils to independently consider the topics you are moving to next to show the depth of their understanding of the area, starting points and reasoning skills to make links with information from previously covered topics to new content.

LO: TO UNDERSTAND MULTI DISCIPLINARY WORKING AND THE MONITORING OF PROCEDURES

Write the date and L/O

Do Now

1.Refresh
What is COSHH?

2. Recap
How can you protect the confidentiality of service users?

3. Relate
How are service users held to account for their actions?

1.Refresh
Explain the use of COSHH to protect SU and SP

2.Recap
Describe the importance of the protection of service user and providers data

3.Relate
Discuss the use of policies and procedures to hold service providers to account for their actions

1.Refresh
Describe COSHH in relation to the disposal of clinical waste to protect SU and SP

2.Recap
Discuss how the Data Protection Act 1998 is designed to protect SU and SP

3.Relate
Justify how training and quality checks can ensure all service providers are held to account for their actions