THE SCIENCE OF LEARNING: PARENT GUIDE

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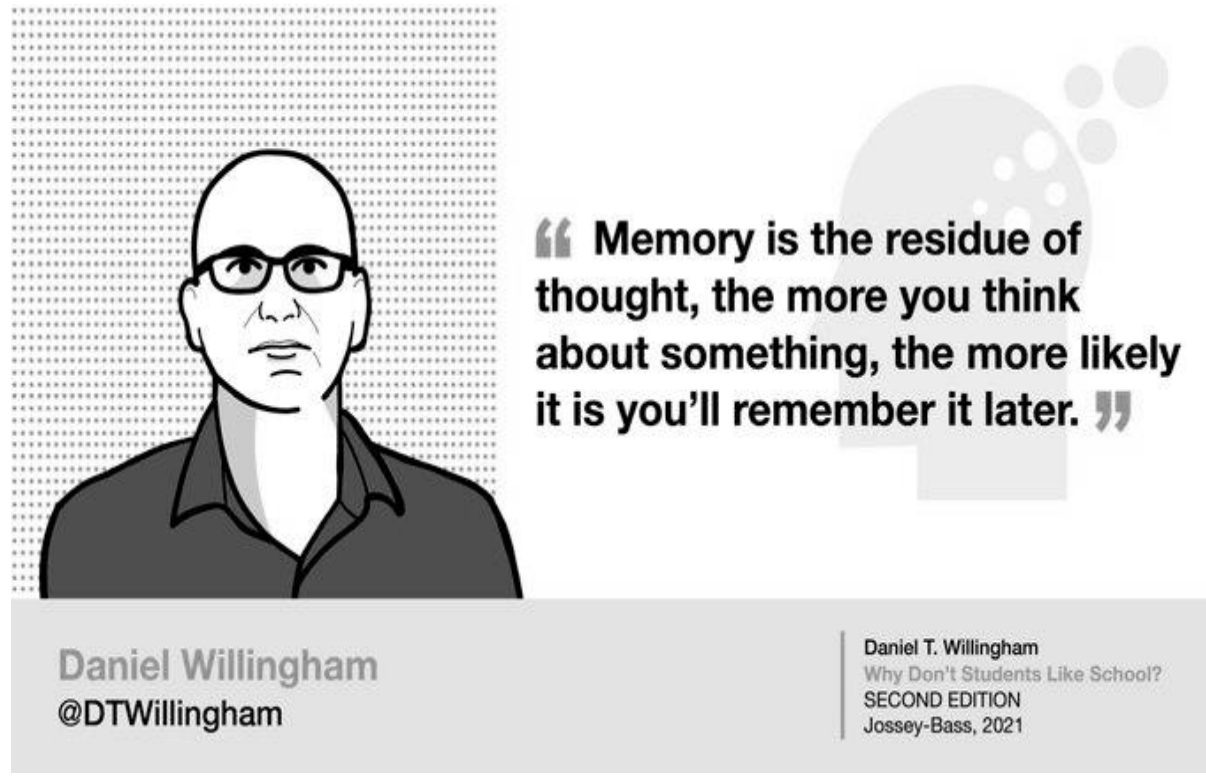
WHAT IS THE SCIENCE OF LEARNING?

Often it can be difficult to decide the methods to study, sometimes the same methods are used, but are these effective? It is important students consider the following aspects when studying outside of the classroom:

- **T**IME- ensure they start early, rather than leaving studying to the last minute. When adopting study habits the goal is to see changes over time, rather than in the short term.
- **I**MPACT- Consider the goal of their study session- be specific in what the area to improve. It is important to focus more on their weaknesses or gaps in knowledge rather than strengths.
- **M**ANAGE- It is important students plan their study time with breaks and ensure your study space is free of distractions e.g their mobile phone.
- **E**VALUATE- when trialling a strategy is important to reflect on how far they are finding it useful and effective.

The science of learning draws on cognitive research of how students think, learn and acquire knowledge. This programme was designed by DCSPD in collaboration with Evidence Based Education, with the goal of teaching the cognitive basis of learning and building more effective study habits. In this parent guide you can find information on each of the 5 themes taught to students, and strategies students can practice to improve their study habits.



The 5 themes of the DCSPD Science of Learning Programme:

1. UNDERSTANDING MEMORY
2. DUAL CODING THEORY
3. RETRIEVAL PRACTICE
4. DELIBERATE PRACTICE
5. SPACING AND INTERLEAVING

UNDERSTANDING MEMORY

A systematic overview of memory processing is taught, drawing on the Multi- Store Model of Memory (MSM) and the Working Memory Model (WMM). This provides an introduction of key concepts surrounding the science of learning such as attention, encoding and retrieval.

DUAL CODING THEORY

The importance of using both verbal and visual stimuli in the encoding and retrieval of information. The misconception of learning styles is tackled. Students practice effective note taking and dual coded flashcards.

RETRIEVAL PRACTICE

The importance of retrieval in the memory process, rather than rehearsal alone, and the power of the testing effect in making information stick. Strategies for retrieval practice taught include graphic organizers, ‘folding frenzy’, brain dumps and peer quizzing.

DELIBERATE PRACTICE

The value of desirable difficulties when studying. 5 stages of deliberate practice are identified:

1) Push beyond their comfort zone
2) Define specific goals
3) Focus
4) Quality feedback
5) Create a mental model of what success looks like.

SPACING AND INTERLEAVING

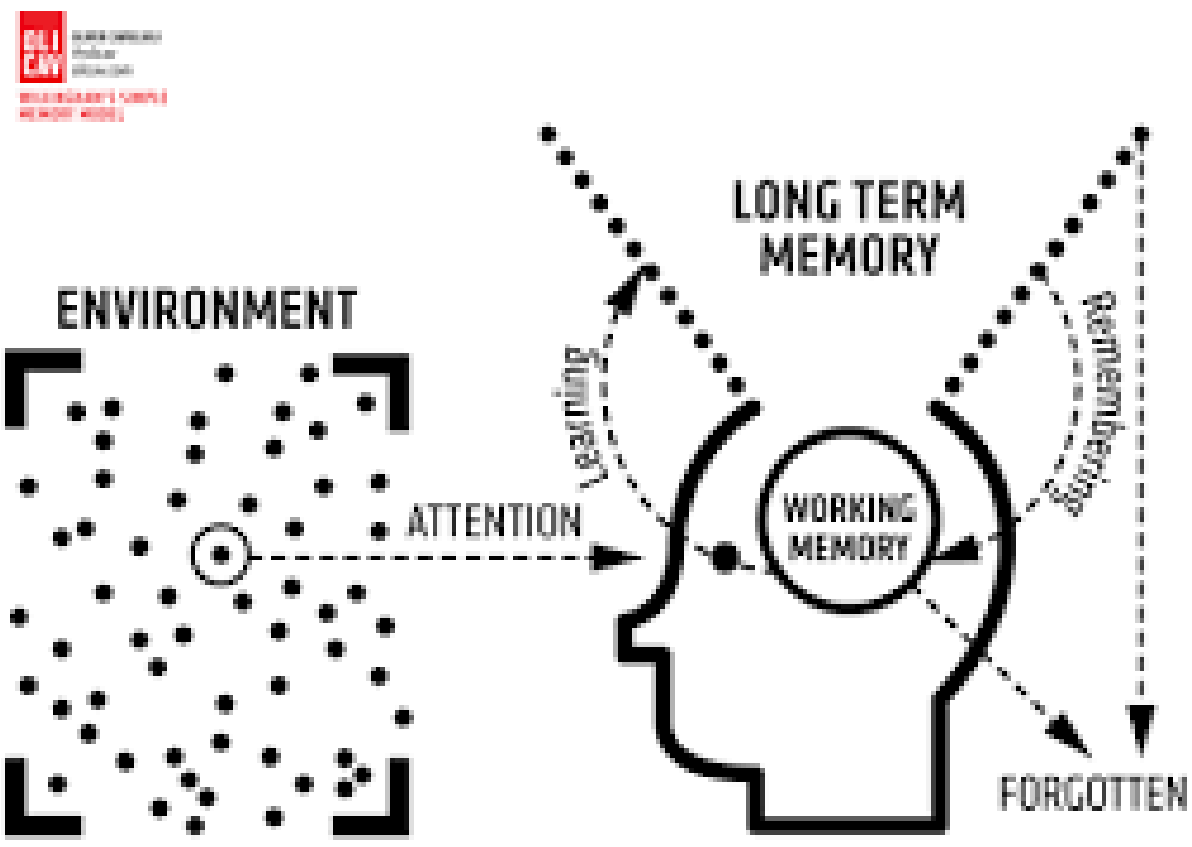
Guidance is given on how to structure your study time effectively. Emphasis is given on spacing their study time rather than massed practice near assessments. The importance of interleaving different topics concurrently is also highlighted. Support is given on how to create study schedules and exam timetables.

1. UNDERSTANDING MEMORY

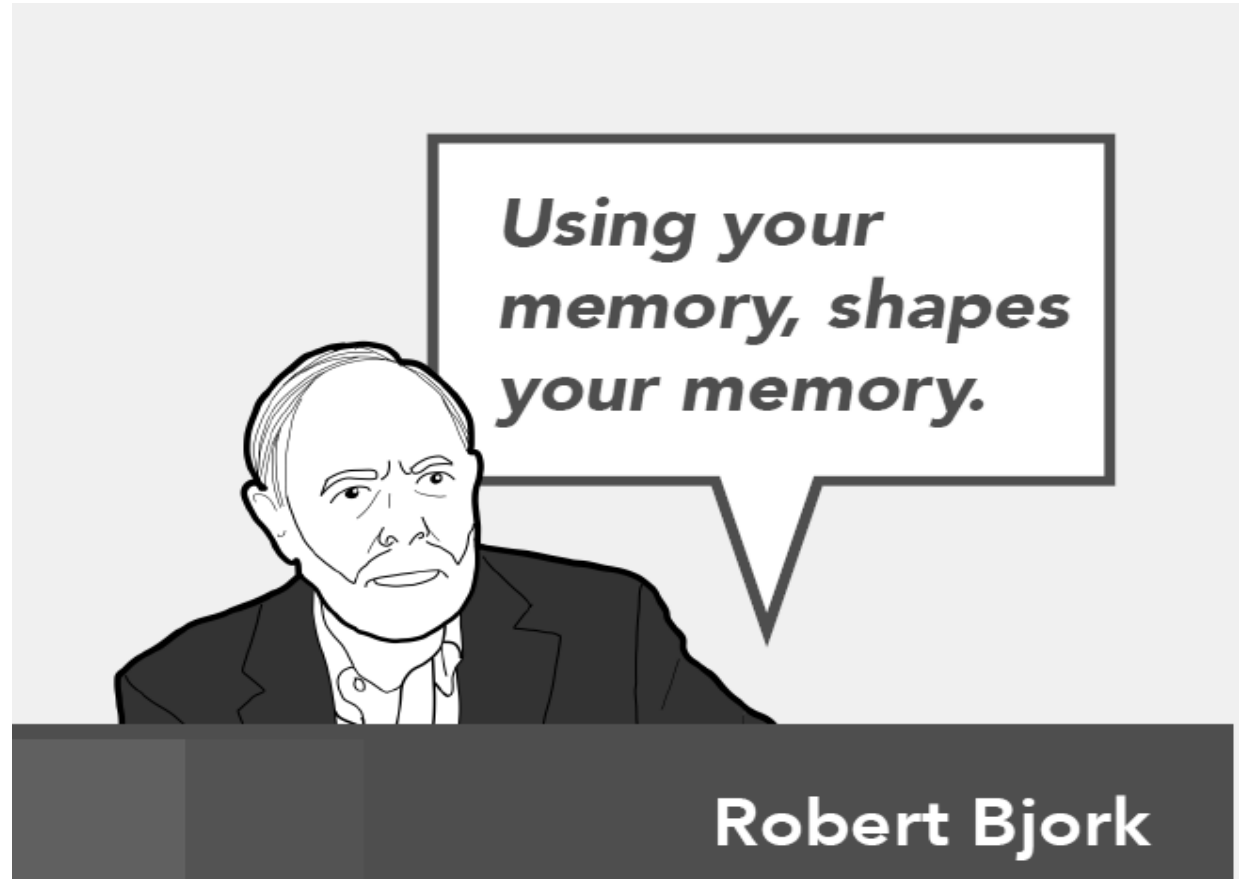
THE BASICS

Watch the video explaining how memory works.

The main application from cognitive science has been research on memory. Memory is integral to the learning process as it allows the processing of information and retention over time. Memory also provides a framework based upon prior knowledge and experience, known as schemas, which help make sense of new information. The diagram below demonstrates the three main processes involved in memory processing: encoding, storage, and retrieval.



- **ENDCODING.** Encoding refers to the process through which information is learned from stimulus in the environment. A key part of information being stored in memory is attention, without attention information will not be encoded successfully.
- **STORAGE.** There are two types of storage; working memory and long-term memory. Working memory has a limited duration and limited capacity. Only 5-9 items of information can be stored at once. Information is transferred to long-term memory through a process of consolidation and learning. Long-term memory has a larger storage capacity and duration.
- **RETREIVAL.** Once information is stored within LTM this information is retrieved and used in working memory. If information is not retrieved this can lead to it being forgotten.



STRATEGIES YOUR CHILD CAN PRACTICE

1 REDUCE DISTRACTIONS

When studying it is important students have a study space is free of distractions which may overload their working memory. This may include removing their phone, only listening to ,music without words and a tidy and clear study space.

2 SIGNAL KEY INFORMATION

If our working memory is trying to process too much information at once this can lead it to be coming overloaded. By signaling key information such as highlighting or underlining, this helps maintain attention on the most important information.

3 PRACTICE RETREIVAL

As mentioned further in the booklet it is important to practice actively trying to remember information needed in a subject, this helps highlight gaps in their knowledge. This will be hard at first- this is good- but then it will become easier.

4 SPACED RETRIEVAL

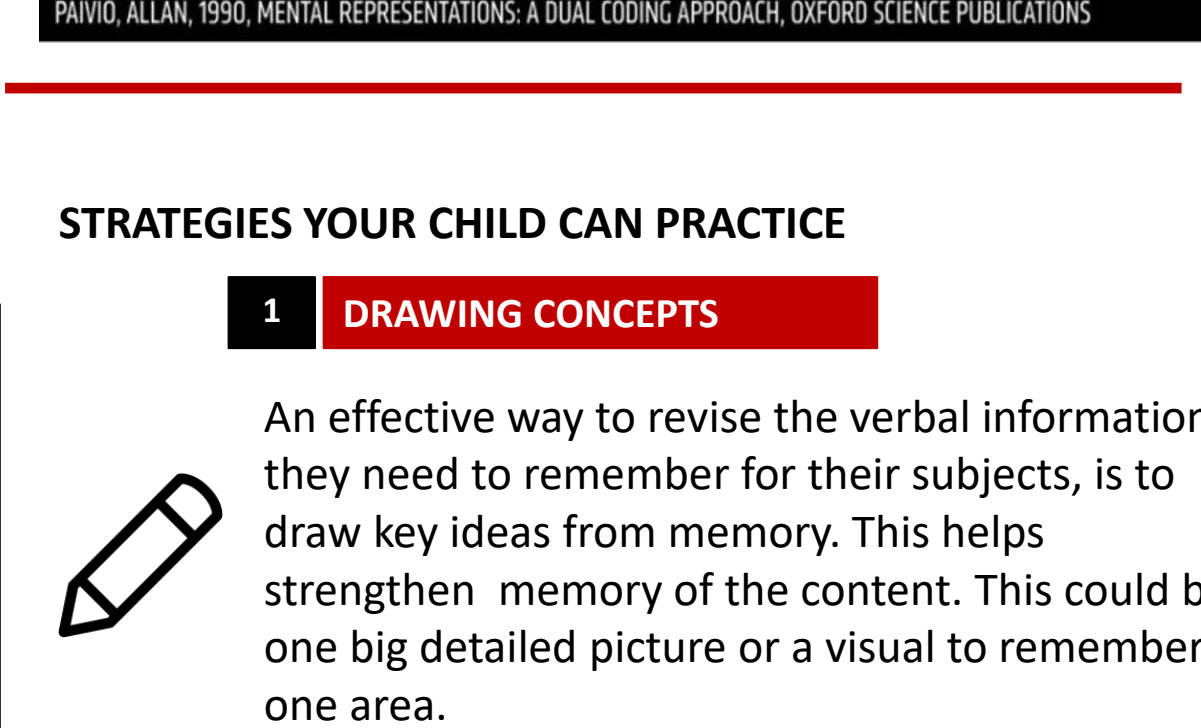
Many of your child's subjects will have a lot of information to know, therefore little and often is the most favored approach to studying. Ensure they mix up their subjects and review all their topics- not just those they are most confident in!

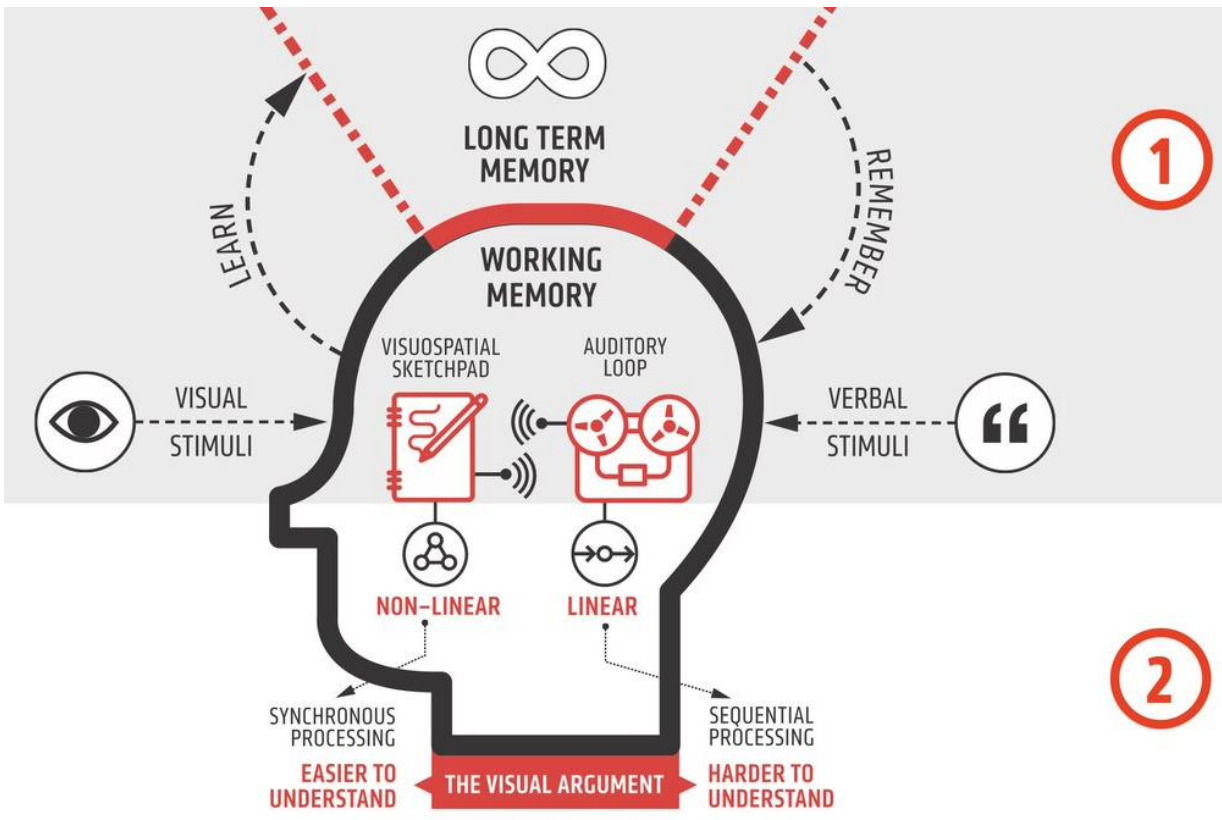
2. DUAL CODING THEORY

THE BASICS

Watch the video explaining dual coding theory.

Dual Coding theory was originally proposed by Pavio (1990) and popularised by Oliver Cavilogli (2019). The premise of the theory is that working memory can be divided into two sub-systems which are separate but connected. One sub-system represents visuospatial information in the form of images, and the other subsystem encodes auditory including verbal information. The activation of both systems by combining words and imagery, provides two ways to encode to the information. Additionally, this associative link aids retrieval from long-term memory, as there are two cues to aid recall. This can include using diagrams, images and graphic organisers in notes and revision. It is important that the visual images used are meaningful to draw connections to the text associated. This increases the effectiveness of the connections as learning becoming multi-modal. This theory illustrates why learning styles are a myth, as all learners are visual learners and importantly images can be easier to understand than text alone. A visual of the theory is shown below.





4 principles to remember when dual coding:

1. ***CUT*** – Be selective and reduce the information to the most important information, to reduce the overload of information.
2. ***CHUNK*** – Try to group the information. To reduce information your working memory is processing Use titles that stands out (font size & weight) and signal the key information.
3. ***ALIGN*** – Make sure words and pictures are next to each other and organsied so they are easily understood.
4. ***RESTRAIN*** – Simple is best, try to avoid too much colour or using too many images. It does not need to look pretty! Students need to consider why they are using the image, how it links to the concepts and whether the image is relevant. The Noun Project is a great website for findings images to use.

STRATEGIES YOUR CHILD CAN PRACTICE

1 DRAWING CONCEPTS

An effective way to revise the verbal information they need to remember for their subjects, is to draw key ideas from memory. This helps strengthen memory of the content. This could be one big detailed picture or a visual to remember one area.

2 DUAL CODED FLASHCARDS

When creating flashcards for a subject. They should have the content (verbal information) on one side and then an associated image on the other side. The image can then be used to remember the text on the flashcard.

3 GRAPHIC ORGANIZERS

The explicit organisation of information helps encoding into long-term memory and the building of meaningful schema (categorization of information). The more organised information is when it is encoded, the easier it is to retrieve it and use in working memory.

4 DIAGRAMS IN CLASS NOTES

When taking notes in class, consider how to present the information being covered. If the teacher says there are 5 parts of something- students should consider a mindmap to help visually remember the 5 parts. If there is a series of steps, consider a flow diagram.

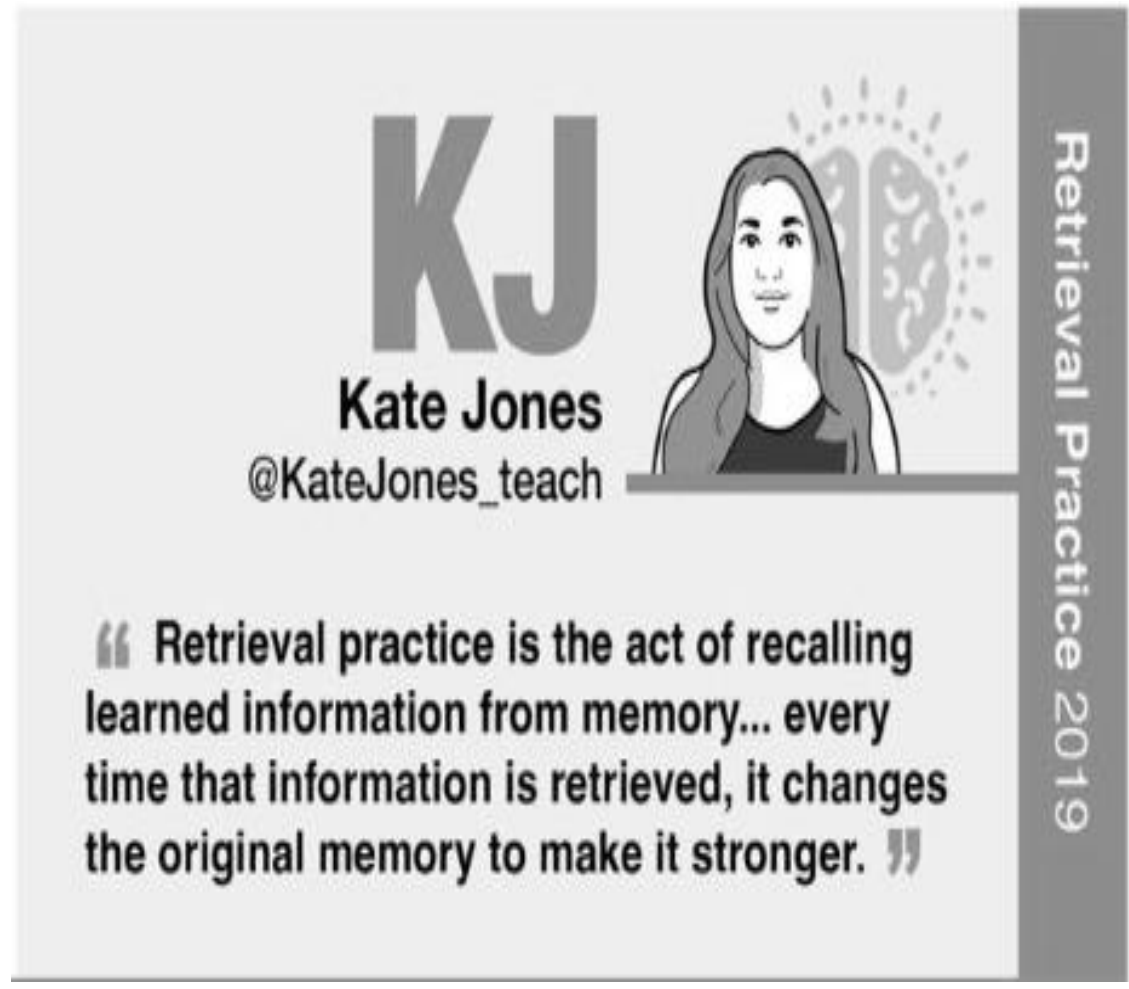
3. RETRIEVAL PRACTICE

THE BASICS

Watch the video explaining retrieval practice.

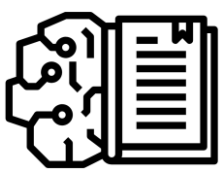
The first step in studying is to consolidate what you have learnt in lesson into a resource to study from,ideally using dual coding, e.grevision notes or flashcards. The resource alone is not effective studying, rather how you use it to retrieve knowledge. Two techniques known as the **Folding Frenzy** and **Graphics organizers** are explained in more detail on the next pages.

Retrieval practice encourages the retrieval of already learned information by trying to recall from memory, using any kind of cue, prompt or question. It is based on the *testing effect.* When rehearsing specific knowledge, we directly activate the relevant neural network and recognise the information as familiar. When *retrieving* information, individuals are required to pave the neural pathway by themselves, forming different associations to identify and activate the sought-after knowledge. By using only *rehearsal* (e.g rereading notes or highlighting) you may bypass the retrieval pathways, leaving them untrained. On the other hand, retrieval activates the association and the context we practice, which further strengthens the connections. Therefore, retrieval practice deepens memory and identifies gaps in knowledge. Re-reading can increase confidence, however it is retrieval practice that has the greater effect on learning.



STRATEGIES YOUR CHILD CAN PRACTICE

1 BRAIN DUMPS



Spend 20 minutes revising their revision resource and then spend fifteen minutes with a blank piece of paper writing down everything they know about a topic. This is a simple and effective way to highlight the gaps in their knowledge.

2 PEER QUIZZING

One of the easiest and most affective forms of retrieval is through quizzing. This could be asking a family member of friend to quiz them on their revision notes, flashcards or graphic organizer. By studying together this can increase your child's motivation.

3 SELF QUIZZING

Similarly, however you quiz yourself rather than having someone else present. You or your teacher may create a quiz on the content covered in the unit. The retrieval practice pack contains templates to focus your self quizzing.

4 THINK ALOUDS

Self-explaining and saying aloud the steps they are taking when solving a problem can deepen their understanding of a topic. An extension of this is explaining their understanding to another person, an example of this is teaching a friend who struggles with a topic.

5 EXAM QUESTIONS

This should be the final type of retrieval activity. Only when they feel confident and secure in their knowledge should they then apply it to practice and exam questions. Students should ask their class teacher for past and practice questions.

STRATEGY IN FOCUS: FOLDING FRENZY

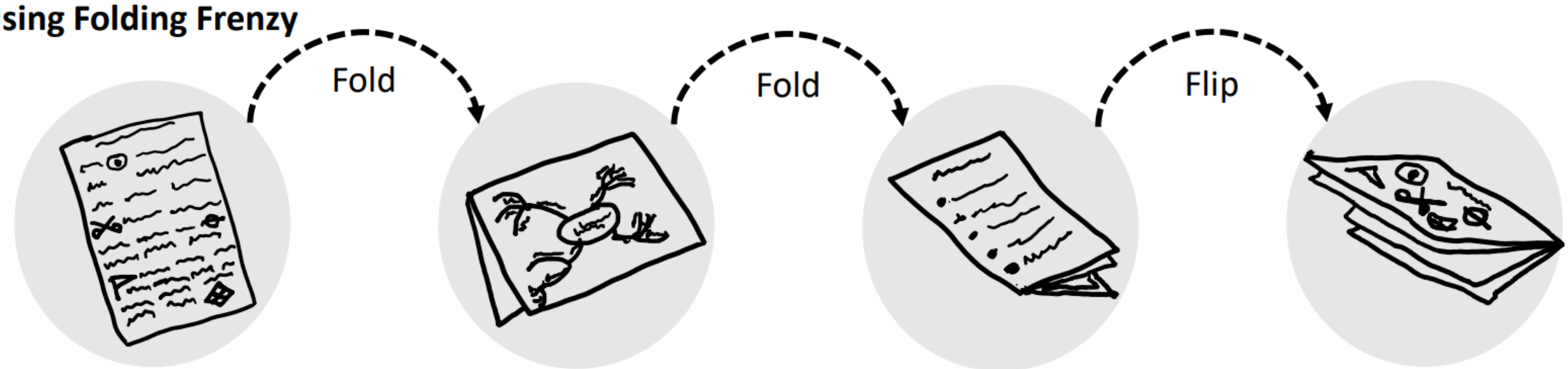
WHAT IS THE FOLDING FRENZY?

Folding Frenzy is a multi layered revision technique that uses a range of strategies together to rigorously encode and synthesize knowledge for effective retrieval practice. Chang & Ku (2014) argue note taking requires effort and encoding which stores the information more firmly in long term memory. Mann (2014) states that graphic organisers, specifically, concept/event maps are a vital tool that aid in the comprehension of the complex material presented in any curriculum. Agarwai et al (2013) States that the more difficult the retrieval practice, the better it is for long-term learning. For instance, recalling an answer to a History question improves learning to a greater extent than looking up the answer in a textbook.

5 tips for making the Folding Frenzy

1. CHOOSE RELEVANT SYMBOLS
2. SIGNAL KEY INFORMATION
3. SUMMARIZE KEY INFORMATION
4. FIND YOUR OWN STYLE
5. TAKE TIME TO MAKE THE RESOURCE

Using Folding Frenzy



Notes

Students write a page of notes on a piece of blank paper on a specifically chosen topic. Focussing on;.

1.key vocabulary
2.summarising content
3.using symbols

Graphic Organiser

Students then create a graphic organiser representing the core terminology of the notes.

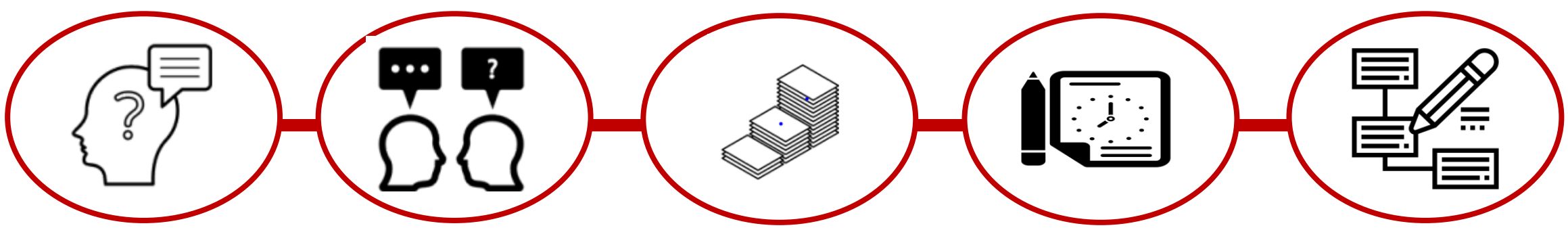
Flashcard

Students write down 5/6 keywords that summarise the topic.

Symbols

Students use the symbols from their original notes.

WAYS YOUR CHILD CAN USE THE FOLDING FRENZY



SELF-TESTING

Use the graphic organizer, flashcards or symbols sides then check their knowledge by unfolding and looking at the detailed notes.

PEER-TESTING

Use the resource to test each others knowledge through retrieval practice questions based on the persons folding frenzy .

BUILDING BLOCKS

Build up their knowledge by practicing in stages:

1) Notes: starting out.
2) Graphic Organizer: understanding but low recall.
3) Flashcard: Almost there. Ask for feedback.
4) Picture side: exam ready.

SPACING AND INTERLEAVING

Whilst is important to use the resource often, It is also important to space out their use of the folding frenzy rather than massed practice near assessments.

ASSESSMENT PRACTICE

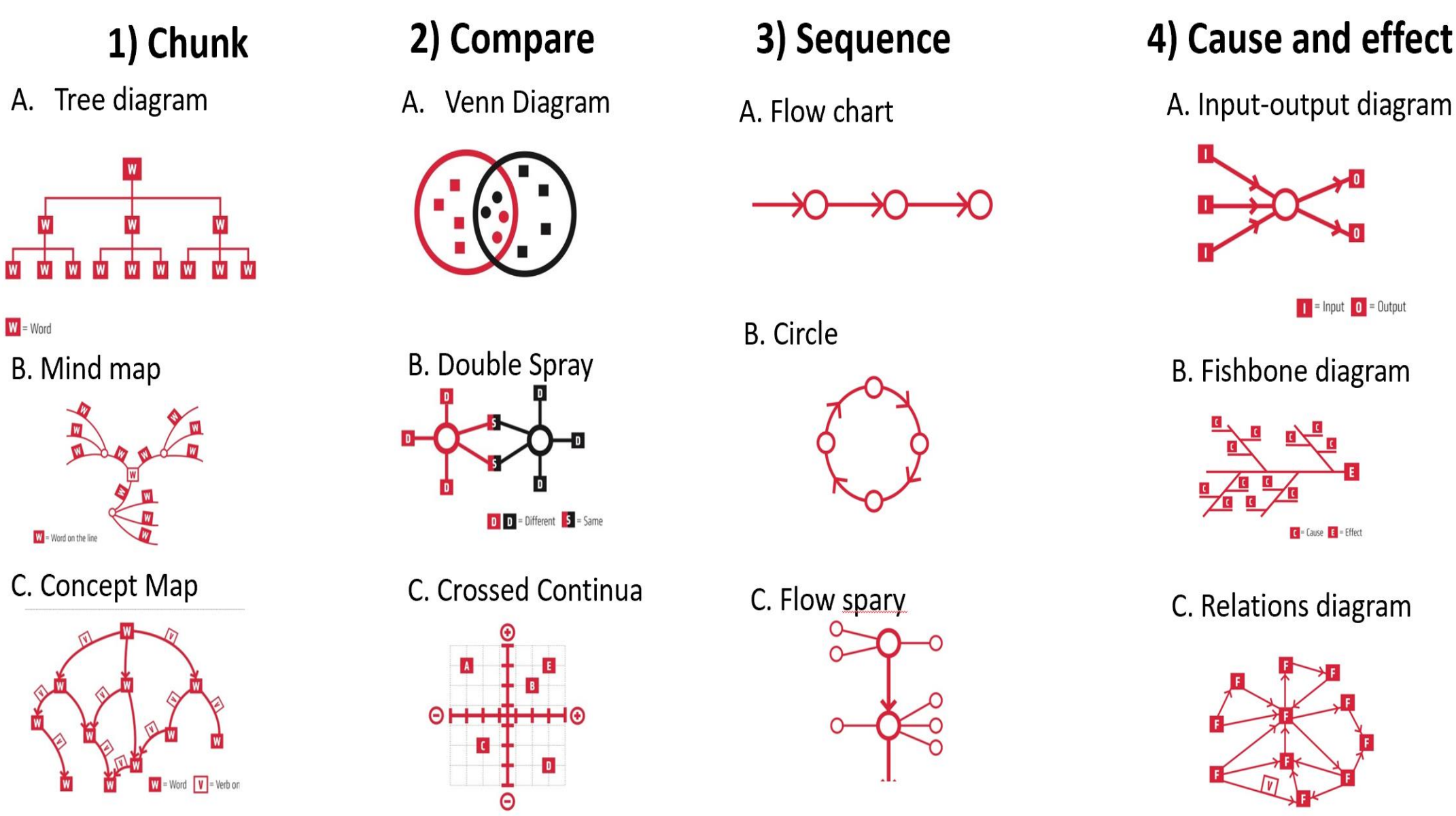
Only once their knowledge is secured should they move on to practicing exam style questions. Application of knowledge is the final stage in the revision process.

STRATEGY IN FOCUS: GRAPHIC ORGANIZERS

WHAT ARE GRAPHIC ORGANIZERS?

Although many students use mindmaps, this is not the only type that can be used! Graphic organisers are a useful way to organise information using both words and images, making use of dual coding, to ensure information is processed in greater depth (Theme 2). This is a great revision resource to clearly consolidate the information that needs to be learnt. Teachers will often provide graphic organizers, however it can be very easy for students to make their own. There are many different types of graphic organisers, which can be used to present information with different purposes. :

- **CHUNKING INFORMATION-** This is one of the most used techniques for organising and arranging a lot of content into smaller units. This allows a hierarchy of ideas e.g a topic area with the content underneath.
- **COMPARING INFORMATION-** These organisers allow information to be compared for similarities and differences.
- **SEQUENCING INFORMATION- T**his is particularly useful when identifying a process or steps that need to be taken.
- **CAUSE AND EFFECT RELATIONSHIPS-** These allow a clear link between an idea and a consequence, they can be useful for looking at factors or themes.



WAYS TO CREATE A GRAPHIC ORGANISER

Students can edit an existing template given by a teacher or create your own using word processor, PowerPoint. Students can also draw them by hand.

There are a number of apps which can be used to help in creating graphic organizers, including:

1. **CANVA**
2. **PADLET**
3. **MINDMEISTER**
4. **COGGLE**

QUESTIONS STUDENTS NEED TO CONSIDER WHEN DESIGNING THEIR ORGANIZER

- *Do I need to place an icon here? Will it have an impact on my learning?*
- *Have I thought about how to use all of the space effectively?*
- *Do I need text to scaffold my organiser within my first draft?*
- *Have I selected a structure that is clear, well-organised and easily understood? Does it fit the purpose?*
- *Have I used signaling to identify the key information? Is it clear or is my working memory being overloaded?*

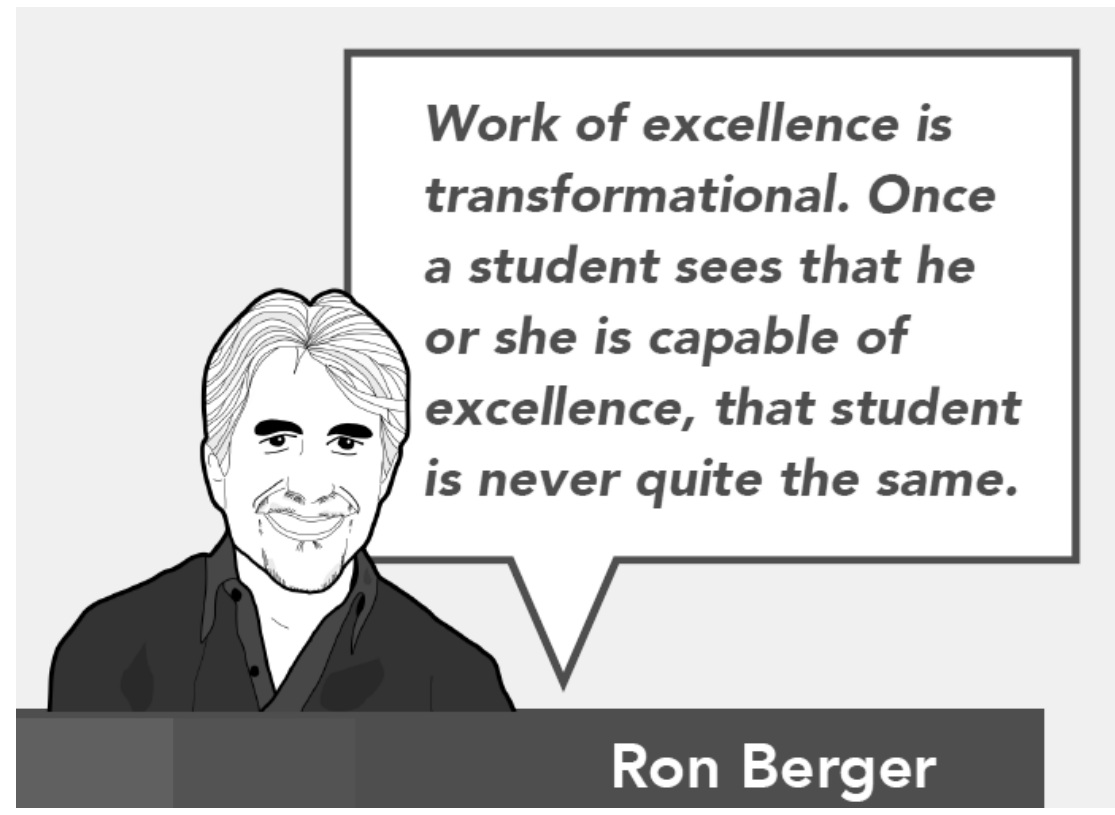
4. DELIBERATE PRACTICE

THE BASICS

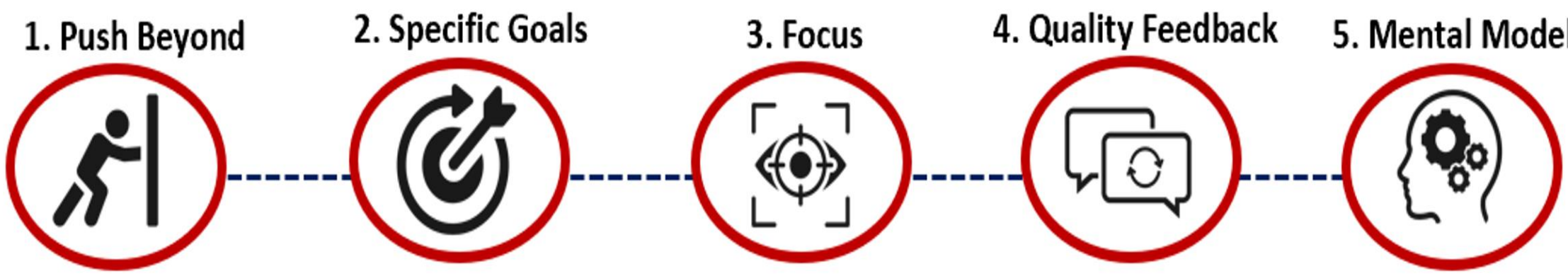
Watch the video explaining deliberate practice

Deliberate practice is practice which is meaningful, with clearly defined goals to improve. This type of practice has been shown to lead to improvement in various fields, however it is only recently being applied to education. It's the act of repeatedly performing certain activities with the intention of improving a specific associated skill. An example would be writing an essay and focusing on critical thinking in the evaluation of points made. There needs to be desirable difficulties, where you feel challenged, with a focus upon quality rather than quantity.

The metacognitive skill of reflection is important when undertaking deliberate practice. Students should ensure dedicate time to understanding the feedback given and their strengths and weaknesses in the skill area. This will allow them to create models of how to undertake the activity and devise a plan for next time to focus on the skill. Experience alone is not enough to improve, rather how the practice is undertaken influences future learning.



Deans for Impact identified 5 key principles of deliberate practice:



STRATEGIES YOUR CHILD CAN PRACTICE

1 FOCUS ON A SPECIFIC SKILL

Identify the area they are wanting to improve upon in an essay question. This could be their knowledge of an area and the clarity in their explanation. It could be their time management, for example trying to practice the response in timed condition. By practicing a specific skills, it improves their focus.

2 REATTEMPT A QUESTION

This may sound strange to rewrite an essay or attempt a question after gaining feedback, but this is one of the best ways to demonstrate a change in understanding and improve. This could be a recent question or one from earlier in the course.

3 LOOK AT MODEL ANSWERS

Look on their class one note or teams for examples of model answers. By looking at the model answer and looking at the mark scheme this will help create a clear understanding of aspects such as structure which led to a successful response.

4 ASK FOR FEEDBACK

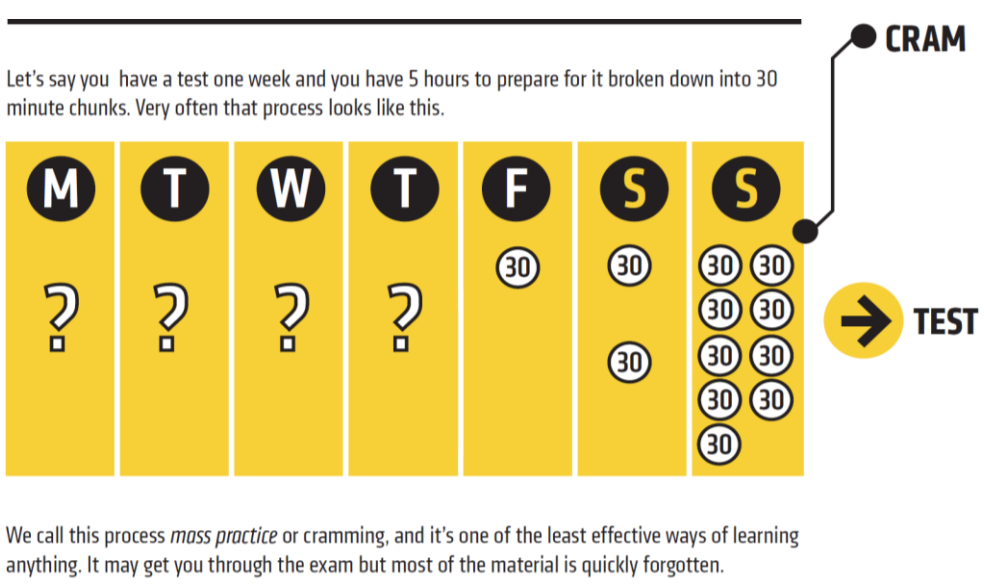
Their teachers are there to support them, they should use them as a resource. Students should ask for regular feedback when they practice deliberate practice- note this does not always need to be marked but could be verbal feedback. .

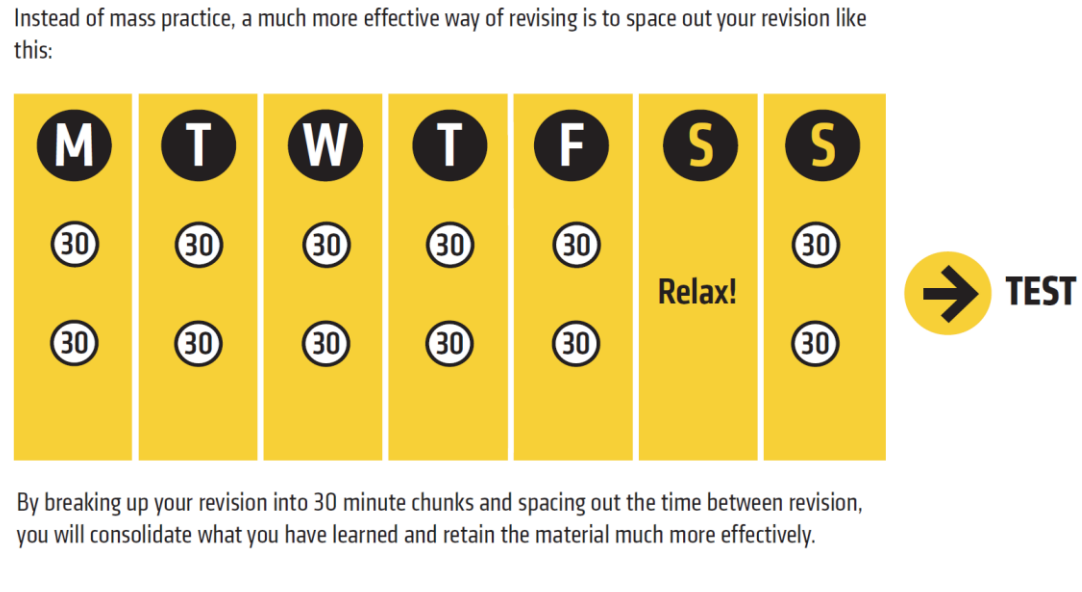
5. SPACING AND INTERLEAVING

THE BASICS

Watch the video explaining spacing and interleaving.

SPACED PRACTICE. Also known as distributed practice refers to the way information is easier to learn if it is learnt in intervals over time. This is in contrast to 'massed' practice where information is learnt in sequential order. When it come to exams and assessments students often adopt this approach by 'cramming' information, however this information is often forgotten afterwards. Spaced practice can be more challenging for students as it prohibits information being held in the working memory, however it increases the likelihood of knowledge being embedded in pupils' long-term memory and highlights areas to review. This can prevent what is known as the forgetting curve, where unless information is reviewed it will be forgotten overtime.





INTERLEAVING. Interleaving involves interspersing topics within a subject rather than being covered through a blocked or consecutive sequence. Instead of studying a unit in one consecutive subsequence, learners should 'mix up' the sequence. Whereas as spacing focuses on the time between study periods, interleaving focuses on what material is being studied.

For example, instead of organising your revision week like this:

M	T	W	T	F
MACBETH	AN INSPECTOR CALLS	CREATIVE WRITING	UNSEEN POETRY	JEKYLL AND HYDE
MACBETH	AN INSPECTOR CALLS	CREATIVE WRITING	UNSEEN POETRY	JEKYLL AND HYDE
MACBETH	AN INSPECTOR CALLS	CREATIVE WRITING	UNSEEN POETRY	JEKYLL AND HYDE

A much more effective way of organising your revision would be like this:

M	T	W	T	F
MACBETH	UNSEEN POETRY	AN INSPECTOR CALLS	JEKYLL AND HYDE	CREATIVE WRITING
AN INSPECTOR CALLS	JEKYLL AND HYDE	CREATIVE WRITING	MACBETH	UNSEEN POETRY
CREATIVE WRITING	MACBETH	UNSEEN POETRY	AN INSPECTOR CALLS	JEKYLL AND HYDE

STRATEGIES YOUR CHILD CAN PRACTICE

1 CREATE A STUDY TIMETABLE

When creating their study timetable, they should ensure there is plenty of time before their exams, to allow spacing. Break each subject in to topics, then divide the schedule into study slots. Plot the topics into the slots- ensuring topics are interleaved.

2 LEITNER SYTEM

After making flashcards it is important to use them regularly. A strategy, known as the Leitner system, uses both spacing and interleaving and encourages students to learn the information they struggle to recall.

3 MAKE CONNECTIONS

When interleaving topics, take time to consider the links that can be made between the topics. Students should identify whether there any connections in terms of concepts which are used, critical thinking points or areas that overlap within the course.

4 FOCUSED STUDY TIME

Divide their study into 45-minute blocks of intense study time. Prior to starting the 45 minutes students should spend 10 minutes planning your approach, then 45 minutes studying and 5 minutes reflecting on areas of uncertainty.

A FINAL NOTE ON WELLBEING

This guide has been written to aid in supporting your child in the most effective ways to revise, so that they can study smarter, rather than for longer. However, when studying there are several key reminders not mentioned in this guide which should be considered.

1 SLEEP

Sleep is one of the most important tools in your learning. When we are sleep deprived, our focus and attention are affected, making it more difficult to encode new information. Our over-worked neurons can no longer function to retrieve old information properly. Students should aim for 8-10 hours a night.

2 START EARLY

This has been hinted at through the guide, however the number one way to prevent stress in your child's studies is for them to start revising early. Speak to any older students and this will be their feedback, they should get their study timetable on the go, practice retrieval and feel assured going into exams.

3 MAKE TIME FOR YOURSELF

Of course, this guide has been about effective studying, however there is a need for balance. Students need to cleave time to do the activities they enjoy whether this is exercise, music or their hobbies. Remember blocks are advised to only be 45 minutes in length- making time for themselves should be the priority.

4 PHYSICAL WELLBEING

Students should maintain physical activities that they enjoy and continue their CCAs at school. If ever they lack focus or feel overwhelmed, a break and a quick walk can help. Drinking lots of water and maintaining a healthy diet are important in our learning but also in regulating our hormone levels.

5 SPEAK TO SOMEONE

Students should maintain contact with their friends and spend time being social. Students are encouraged to speak to a friend, teacher, parent or a trusted adult if they feel that they are struggling in their studies. There are a lot of people here to support them on their educational journey.

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