

Learning and understanding scientific concepts

This guide reinforces strategies identified and explained in the related Studying in the sciences guides:

- Understanding how information in science is organised
- Learning and recall of scientific terms

As well as providing new other strategies on the topic.

Studying in the Sciences

What is in this resource

- Main approaches
 - Spacing out your learning (distributed practice)
 - Testing yourself as you go
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Main approaches

Evidence supports that two of the most useful strategies to help you learn new information are:

- spacing learning (distributed practice)
- and
- testing yourself as you go

Spacing out your learning

Spacing out your learning is commonly called distributed practice, and as the name suggests, it involves spreading out study sessions over time rather than massed practice (or cramming). Spacing your learning allows time for consolidation of new information and for you to build a background as you go. It also uses what we know about the nature of short-term memory and thereby promotes more meaningful learning. Evidence strongly supports distributed practice for deeper learning and information retention as opposed to cramming that promotes rote learning.

How to approach it

- For this approach to be successful you need to be motivated and disciplined to allocate and use frequent, regular, short time periods dedicated to learning your unit content.
- **Organise your time and formally plan these sessions** into your study schedule. The key elements to timing of these sessions are: they need to be **frequent; regular** throughout the teaching session; of **short duration**, and allow for **revisiting of content**.
 - For example, set aside one 50 minute study session per week from the start of session for each unit of study (subject) to understand and learn the information covered that week. This should be in addition to other learning activities set by the unit assessor/ educator for engaging with the unit content (e.g. preparation for class, readings and discussion boards). You may need to increase the frequency of the learning session over time or as content workload demands it.
 - You need to tailor the frequency and duration of the learning sessions to your own learning needs. For example if you find you can focus and learn effectively for only 30 minutes and struggle with anything after that you would be better to set aside 2 x 25 min sessions that are spaced out (with something else not study related in between).
 - It is important to go over the information several times to promote it to longer term memory. Don't just go over it once- revisit.

- **Engage with the content you need to learn.** You need to implement meaningful strategies to learn and understand your materials. Use the time you have set aside effectively: don't just highlight and re-read notes and readings. Consciously and purposefully direct your attention to what you are trying to learn. You need to understand your materials to enable meaningful learning. Such strategies for understanding and learning are provided later in this guide.
- **Test what you have learnt** to identify areas that need further revision or clarification.

Test yourself as you go

This approach should be used together with spacing out your learning as it allows you to self-evaluate what you do and do not know and/ or are having difficulty recalling or applying.

There are many strategies you can use to 'test yourself as you go'. Common and helpful methods include the use of flash cards, answering questions (such as from textbooks or practices questions and quizzes on unit sites and passed exams) and explaining concepts to others. Such strategies will be explained in more detail later in this guide.

Strategies for understanding and learning

So you have organised your time for spaces-out learning approaches, now what learning strategies can help to effectively use this time?

An important part of the learning process is to make sure you understand the information, so first we will look at some of the strategies that will help with understandings and thereby, in turn, learning.

Understanding to enable learning

The first thing is to ensure you understand the material. You are more likely to remember information that you understand. If you know how things work, or how concepts connect together it is easier to remember and recall details without just trying to memorise them. If you can understand how a certain system is organised then you can more easily recall individual components of that system, that is, it is easier to remember items that you can arrange in a logically organised manner.

A good way to help understand scientific concepts is to think about how information is typically organised in science and how concepts inter-relate. For more information on this see the Studying in the sciences guide: *Understanding how information is organised*.

Organising ideas

Systematically organising ideas helps you to understand these ideas or concepts by making links between them. It is important to pull out concepts from your notes and categorise them in a way to help you remember them rather than just reading and re-reading the information. Another thing to try is to represent the material differently as you review it or check your understanding of it.

Tip

Don't do the same thing with the information each time. Strategies could include making *tables* (or charts), drawing *mind maps* and *grouping* things. As you do this, consider how each bit fits together. For more information on how to effectively organise information and take notes see the Academic Skills Quick Guides: [Brainstorming and mind-mapping](#); & [Taking notes](#).

Connect new information with what you know

As you continue to study in science, foundational concepts are further developed. You will see how things connect and relate to things you have previously learned. By finding these links and connections it will make it easier to remember and apply the information you are learning.

Use new information in a meaningful way

It is important to apply information in different contexts to aid in comprehensions and recall. Try to represent the material in different ways; do not do the same thing with it each time. For example, if you were trying to learn the what muscles are supplied by a certain nerve, rather than just repeating the names of the muscles

supplied by this particular nerve you could try to identify what functional movement loss would occur if the nerve was damaged. By doing this you are applying the information in a new and meaningful way.

In the sciences application of theoretical and conceptual information into a real life scenario is particularly important. Including real life examples in your study will help you understand and remember the information.

Other strategies to help memory and recall

Learn root terms, prefixes and suffixes

To assist with understanding and remembering scientific terminology (see Studying in the sciences guide: Learning and recall of scientific terms).

Keep a glossary

To assist with learning scientific terminology (see Studying in the sciences guide: Learning and recall of scientific terms).

Utilise various sensory input (e.g. hear, see, touch) to help you learn and remember

Try to incorporate multiple senses into your learning. Every day, as we interact with the world around us, we use our senses to help take in information and remember it. You can actively utilise your various senses to try to remember things you are studying. Information tends to be retrieved by the same methods it was stored, thereby applying sensory triggers to help you remember, and then utilising these triggers to assist with recall can be a useful study strategy.

Now thinking about the common senses you could easily apply to studying, rather than just attending to information one way, try to incorporate as many senses as possible. For example, reading aloud rather than just visualising and processing the words engages the auditory senses (hearing) as well. Convert the words you have read into a picture or map, drawing it on paper, again utilising visualisation but also engaging movement strategies (part of kinaesthetic senses) as you create the picture. Additionally, you are using the information in a different way, a strategy that has already been emphasised to help you learn and understand. Rather than just reading words about things, use models and figures (including those in text books) that present information. This may include 3-D models like atoms or anatomical parts, feel the object as you try to learn about it. When studying anatomy use your own body or study partner to identify and visualise. Feel and trace the attachments and course of a muscle the joint line between two bones, incorporate the kinaesthetic and visual senses.

Further tips

How to help remember what you are studying using your senses see the web page from Open Polytechnic, New Zealand – use your senses and imagination available via open access from <http://www.openpolytechnic.ac.nz/study-with-us/study-resources-for-students/how-to-study-concentrate-and-remember-what-you-ve-learnt/how-to-improve-your-memory/use-your-senses-and-your-imagination>

Chunking

Chunking is a technique to help memory by arranging or combining individual pieces of information into a single unit or 'chunk'. You then remember the information as a chunk rather than each piece separately. These chunks are easier to remember than each individual piece of information and can also be categorised to provide cues, allowing for easier information recall.

The typical example that is given when the concept of chunking is being explained is trying to remember 10 digit numbers, such as a mobile phone number. It is much easier to remember if you break it into chunks of information. Rather than learning all 10 digits individually (0-4-1-9 -1-5-1-3-0-7), typically, this series of numbers would be learnt as three chunks (0419 -151-307) making it easier to memorise and recall.

Chunking into meaningful groups that you categorise and the learning these groups is also helpful. This applies the concept of organising information as well as chunking. For example, a grocery list of 16 items (*scouring pads, bananas, milk, cheese, toilet paper, potatoes, toothpaste, strawberries, capsicum, yoghurt, dishwashing powder, shampoo, garbage bags, ice cream, carrots and bleach*) would be quite difficult to remember. By

chunking the list into meaningful sections and remembering how many items are in each chunk, then learning the chunk rather than trying to remember individual items, can aid recall. You should chunk the information in ways meaningful to you. This might be, for example, chunking into related product groups and remembering these chunks: dairy (4 items- milk, cheese, yoghurt, ice cream); toiletries (3 items – *toilet paper, toothpaste, shampoo*); cleaning products (4 items – *scouring pads, dishwashing powder, garbage bags, bleach*); fruit and vegetables (5 items – *bananas, potatoes, strawberries, capsicum, carrots*).

You can apply similar strategies to learning things in science, particularly where you need to recall lists or groups of information. Identify ways, meaningful to you, to chunk the information and try to learn each chunk as a group rather than all the pieces of information individually.

Associations and Mnemonics

These are systematic strategies that use any association or connection, to help remember and recall information. Try using things like chants, songs, sayings and sentences that you can make up to help you to remember ideas and concepts. Try using the following:

Rhymes make things easier to remember. (For example, to remember how many days are in each month, we learn the rhyme: 30 days has September, April, June and November...)

Acronyms are abbreviations which use the first letter of words. (For example, to remember the colours of the rainbow, we make a name that contains the first letter from each colour, in the correct order: Roy.G.Biv (red, orange, yellow, green, blue, indigo, violet).

Acrostics take the first letter of words we want to remember and make a new sentence out of words starting with those letters. An acrostics mnemonic for remembering the planets:

- **My Very Excellent Mother Just Served Us Nachos**
- = **Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune**

These types of strategies require regular revision and repetition and therefore can be time consuming. It is important to determine if it is more time efficient to learn the original information itself rather than developing and remembering mnemonics.

Test what you know

You need to self-evaluate your learning to determine what requires further attention. The following provide example of strategies that you can use.

Flash cards

Create flash cards. Write a question on one side and an answer on the other, or a word on one side and a definition on the other. Test yourself. Re-read the ones you do not know the answer to and then try again. Get in a study group; create flash cards to share around.

Explain what you know to someone else

A good way to check your understanding is to explain the concept (or thing) to someone else in everyday, simple language. Where you stumble or struggle or the person is at a loss to what you are saying, it is likely you do not have a good grasp of that aspect of the concept. Use this to know what content you need to revisit. If the person you are explaining it to is not in your field of study and they can understand it, then you probably have a good comprehension of the content.

Do practice questions

Be on the lookout for practice or sample questions to do to test what you know. These can be found, for example, at the end of text book chapters and on your unit blackboard site as practice quizzes and exams. You could get in a study group with peers and test each other. Once you have identified any gaps in your learning make sure you follow this up and revisit the relevant material or seek assistance from your tutor/ educator.

Other related guides

- Understanding how information is organised (Studying in the Sciences guide)
- Learning and recall of scientific terms (Studying in the Sciences guide)
- Brain storming and mind-mapping ([Quick Guide](#))
- Taking notes ([Quick Guide](#))
- Preparing for exams ([Quick Guide](#))

Other helpful resources

The following resources, from the University of Melbourne, are tailored for studying in the sciences and are available via open access.

University of Melbourne. (n.d.). *Remembering facts for science students*. Retrieved from http://services.unimelb.edu.au/__data/assets/pdf_file/0008/471266/Remembering_facts_for_science_students_Update_051112.pdf

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University of Melbourne. (n.d.). *Improving your memory – for science students*. Retrieved from http://services.unimelb.edu.au/__data/assets/pdf_file/0003/675705/Improving_your_memory_science_Update_051112.pdf