

Atheneum

The Atheneum Study Guide

Practical, research-backed ways to study, with sources

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Each guide explains one technique, what the research says about it, and how to try it the same day. Sources are listed at the end of each guide.

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GUIDE 1 · MEMORY · 7 MIN READ

Active Recall vs Rereading: What Works Better

Why rereading feels effective but often isn't, what research on self-testing says, and how to swap passive review for active recall without extra study time.

THE SHORT ANSWER

Active recall works better. In a 2006 study, students who tried to recall a passage remembered more a week later than students who reread it, though rereading scored better a few minutes afterward. Rereading feels effective because familiar material seems known. Read once, then spend most of your revision with the book closed, recalling and checking the gaps.

Most students revise by rereading: going back over notes, slides or a textbook chapter until it feels familiar. It is the default method, and it is among the least effective ones. This guide explains why, what the research says, and how to swap rereading for **active recall** without studying any longer.

What the two methods are

Rereading is looking at material again. You read your notes, reread the chapter, or skim your highlighting.

Active recall is pulling information out of your memory instead of putting it back in. You close the book and try to answer a question, write down what you remember, or explain an idea from scratch. Researchers often call it *retrieval practice* or the *testing effect*.

The difference is the direction of effort. Rereading asks you to recognize something that is on the page. Active recall asks you to produce it from nothing, which is exactly what an exam asks you to do.

Why rereading feels so effective

Rereading has a trap built in. The second time you read something, it is easier and smoother, because you have just seen it. That ease feels like learning. Psychologists call this the *illusion of knowing* or *fluency illusion*: the material looks familiar, so you assume you could produce it.

But recognizing a page is not the same as recalling what is on it with the page closed. The gap only becomes obvious when you sit down to a blank answer sheet, which is too late to fix it.

Active recall feels harder and more uncomfortable, and that is a reason students avoid it. The effort is the point. It is also honest feedback: if you cannot recall something, you have found a gap while you still have time to close it.

What the research says

The testing effect is one of the most replicated findings in the science of learning. In a well-known 2006 study by Roediger and Karpicke, students who studied a passage and then tried to recall it remembered more a week later than students who simply reread it, even though rereading did better on a test a few minutes afterward. Rereading can look like it works if you only check straight away.

A broader 2013 review by Dunlosky and colleagues, which compared ten popular study techniques, rated practice testing and spaced practice as the most useful, and rated rereading and highlighting as having low utility. That does not mean rereading does nothing. It means that, for the same time, other methods do more.

A few honest caveats:

- Results depend on the material, the age of the learner and how the recall is tested, so treat the findings as strong general guidance, not a guarantee.
- Active recall works best on material you have already studied once, and it is a way to retain and find gaps, not a way to learn something for the first time.
- If you want the details, read the original sources yourself rather than taking a summary on trust.

When rereading is fine

Rereading is not useless. It is a reasonable way to:

- **Read something for the first time.** You need to meet the material before you can recall it.
- **Understand something confusing.** If you did not follow an explanation, reading it again, or from a different source, is the right fix.
- **Check your answers.** After a recall attempt, going back to the source to compare is exactly how you find what you missed.

The problem is using it as your main revision method, with the feeling of familiarity as your measure of progress.

Ways to do active recall

You do not need special tools. Common methods include:

- **Blurting:** close your notes and write everything you remember about a topic, then check what you missed.
- **Flashcards:** answer one specific question at a time, with the answer hidden.
- **Practice questions and past papers:** the closest thing to the real exam, and the best test of whether you can apply what you know.
- **Questions in the margin:** while you read, write a question beside each key point. Later, cover the notes and answer the questions.

- **Explaining aloud:** teach the topic to an imaginary student, or a real one. Where you stumble is where you do not understand it yet.
- **Closed-book summaries:** write a one-page summary of a lecture from memory, then compare it with your notes.

How to switch from rereading

You do not need to throw away your routine. Change what you do with the time:

1. **Read once, carefully.** Do a real first pass, with a question in mind for each section.
2. **Close the book and recall.** Spend the next ten minutes writing, saying or answering what you remember, before you look again.
3. **Check and fix.** Open the source, compare, and mark what you missed or got wrong.
4. **Restudy only the gaps.** This is where your rereading belongs: targeted, after you know what is missing.
5. **Do it again later.** Come back to the same topic after a day or two, then after a week. Spacing the recall makes it last.

A rough rule: spend more of your time retrieving than reading. If you are revising for an hour, most of it should be spent with the book closed.

Make it hard enough, but not too hard

Recall works best when it takes some effort but you can usually succeed. If you cannot remember anything, you are testing too early or the chunk is too large. Go back and study it, then try again on a smaller piece. If every answer comes instantly, the material is already solid and you can space it out further.

Feedback matters too. Always check your answers afterward. If you recall something wrongly and never check, you risk reinforcing a mistake.

Common mistakes

- **Treating recognition as recall.** Looking at the answer and thinking "yes, I knew that" is not recall. Commit to an answer before you look.
- **Giving up after one bad attempt.** Early attempts are supposed to be messy. The method works across repeated tries, not on the first one.
- **Skipping the check.** A recall attempt with no comparison is half a method.
- **Doing it once.** A single test the night before beats nothing, but spread attempts over several days.
- **Only doing what feels good.** The uncomfortable topics are the ones that need recall most.

Doing this in Atheneum

You can practice active recall with nothing but paper, and the timer, notes and task board help you run it. In Atheneum, the Review tool is built around it. Studying flashcards and Blurt Mode are free on every plan, and anything the AI generates uses AI credits (the free plan includes a small monthly allowance):

- **Flashcards:** generate a deck from a notebook's files, or import one from Anki, and study it with spaced repetition.
- **Blurt Mode:** write what you remember about a file with your notes hidden, then select **Check with Athena**: she lists the file's key points and marks which ones you covered, half-covered or missed.
- **Quizzes:** generate a quiz from a notebook at the difficulty and length you choose, take it one question at a time, and have Athena grade your answers with feedback. Review's **Up next** suggests which quiz to take again. The result shows what you missed and points to the notebook's summaries, study guides or cards that cover it. Quiz generation is on every plan and uses AI credits.

AI-generated cards, checks and quizzes can contain mistakes, so check them against your own material before you trust them. The features page shows how Review fits with the rest of the workspace, the documentation covers each tool, and the pricing page shows what each plan includes.

To fit this into a plan before an exam, see how to build an exam revision timetable.

A quick start

1. Pick one topic you have already studied once.
2. Close your notes and write or say everything you remember for five to ten minutes.
3. Compare with your notes and mark the gaps.
4. Restudy only the gaps, then try again in two days.

Spend your next revision session this way instead of rereading, and compare how it feels. The discomfort is a sign that it is working.

Read next: how to read a textbook so it sticks, does highlighting work? and why you think you know it.

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Online: atheneum.app/guides/active-recall-vs-rereading · Updated 2026-10-25

GUIDE 2 · MEMORY · 6 MIN READ

Blurting Method for Studying: How It Works

What the blurting method is, why recalling from memory beats rereading, and a step-by-step way to try it, including where it falls short.

THE SHORT ANSWER

Blurting is free recall: after studying a small topic, you hide your notes, write everything you remember for five to ten minutes, then check against the source and mark what you missed. It works because retrieval practice beats rereading for the same time, and it shows your gaps. Restudy only the gaps, then blurt again a few days later.

The blurting method is simple: after studying a topic, you close your notes and write down everything you can remember, then check what you missed. It is a form of **free recall**, one of the most reliable ways to find out what you actually know. This guide explains why it works, how to do it step by step, and where it falls short.

What blurting is

Blurting has three parts:

1. **Study** a small chunk of material.
2. **Blurt**: with your notes hidden, write, draw or type everything you can remember about it, in any order and without stopping to look anything up.
3. **Check**: compare what you wrote with the source, mark what you got right, and note what you missed or got wrong.

The name comes from the idea of "blurting out" what you know. It is not a new technique so much as a popular, practical name for free recall: producing information from memory with no prompts.

Why it works

Recognizing something on a page is much easier than producing it from memory, which is what an exam asks you to do, and rereading hides that gap. Blurting closes it. It is a form of retrieval practice, which research consistently finds beats rereading for the same amount of time (see active recall vs rereading for the details). It also gives you clear feedback: whatever you could not write is exactly what you need to study again, so you spend your time on the weak spots rather than on what you already know.

A useful side effect is that it shows you the shape of your knowledge. You often find that you remember the main idea but not the details, or the facts but not how they connect. Both are worth knowing.

How to do it, step by step

1. Choose a small chunk. One lecture, one chapter section, or one topic you could explain in a few paragraphs. A whole textbook chapter is too much for a first try.

2. Study it first. Blurting tests what you have learned. It is not a way to learn something from scratch, so read or review the material before you start.

3. Hide your notes. Close the book, turn the page over, or minimize the file. If you can see the source, you are not recalling anything.

4. Set a time and write. Five to ten minutes is plenty. Write everything you remember: definitions, steps, names, dates, examples, how ideas connect. Do not worry about neatness or order. If you get stuck, move on to another part rather than staring at the page.

5. Stop and check. Open your notes and compare. Use a different pen color or a separate section for anything you missed or got wrong, so the gaps are visible at a glance.

6. Restudy the gaps. Spend your next study block on what you missed, not on the whole chunk again.

7. Blurt again later. Repeat the same topic a day or two later, then a few days after that. Each round should show fewer gaps. Spacing the attempts out helps the memory last.

A short example

Say you have studied how a bill becomes law. In your blurt you write the main stages from memory, then check the source and find you forgot the committee stage and mixed up the order of two steps. You mark both in red. Your next study block focuses on the committee stage and the correct order. Two days later, you blurt the topic again and cover everything except one detail, which becomes your next gap.

Variations

- **Diagrams and mind maps.** For topics with structure, such as processes, systems or relationships, sketch a map from memory instead of writing paragraphs.
- **Saying it aloud.** Explain the topic out loud as if teaching it. It is quicker and works well when you have no paper.
- **Timed rounds.** Give yourself a fixed time, then try to cover more in the same time on the next round.
- **Question prompts.** For subjects where open-ended recall is too hard, write a list of questions first and answer them from memory.

Blurting compared with other methods

Method	What you do	Best for	Weak spot
Rereading	Read the material again	A first pass over new material	Feels productive, builds little recall
Flashcards	Answer one specific prompt at a time	Facts, terms, definitions	Narrow, and misses how ideas connect
Blurting	Recall a whole topic with no prompts	Finding gaps and seeing the big picture	Hard on new material, and easy to mark yourself too kindly
Practice problems	Apply the idea to new cases	Math, sciences, anything procedural	Needs good problems to practice on

They work well together. Blurting is good for finding what you do not know, and flashcards are good for drilling the small facts you find.

Where blurting falls short

- **It does not replace learning the material.** If you have barely studied the topic, a blurt will mostly show a blank page. Study first.
- **It can feel discouraging.** An empty or messy page is normal early on. That is the method working: it shows where the gaps are while you still have time to fix them.
- **You can mark yourself too leniently.** "I basically knew that" is not the same as having written it. Count a point only if it is actually on the page.
- **It is not ideal for every subject.** For problem-solving subjects, such as math or physics, working through problems is usually a better test than recalling a description of the method.
- **Exact wording is a trap.** Aim to recall the idea in your own words. Memorizing a sentence does not show you understand it.

Doing this in Atheneum

Atheneum has a Blurt Mode in the Review tool. You pick any file in a notebook, then write what you remember with your notes hidden and a timer running. When you're done, Athena, the AI tutor, checks what you wrote against the file itself: she lists the file's key points, marks each one as remembered, partly there or left out, points out anything you got wrong, and gives you a score for how much of the file you covered. Your rounds are saved, so you can see the score change when you blurt the same file again a few days later.

Writing a blurt is free on every plan; Athena's check uses a few AI credits, and the free plan includes a small monthly allowance. The check is done by an AI, which can miss a point or misjudge one, so glance at the "left out" list against your own material before you trust it. A scanned PDF with no text in it can't be checked. The features page explains how the Review tool fits with the rest of the workspace, the documentation covers uploading files, and the pricing page shows what each plan includes.

Blurting pairs well with the other guides here. Turning your material into flashcards helps with the small facts blurting reveals, organizing your notes by subject makes it easy to find the right chunk to blurt, and short timed blocks suit a ten-minute blurt followed by a check.

A quick start

1. Pick one topic you have already studied, small enough to cover in ten minutes.
2. Hide your notes and write everything you remember for five to ten minutes.
3. Check against the source and mark the gaps in a different color.
4. Restudy only the gaps, then blurt the same topic again in two days.

You do not need any tools for this. A blank sheet of paper and a timer are enough to start.

Sources

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Online: atheneum.app/guides/blurting-method-for-studying · Updated 2026-10-23

GUIDE 3 · MEMORY · 6 MIN READ

How to Turn PDFs and Lecture Notes into Flashcards

How to turn PDFs and lecture notes into flashcards that work: what a good card looks like, a step-by-step method, and how to check AI-generated cards.

THE SHORT ANSWER

Skim the material first, pick the ideas you would need to recall in an exam, and write each card from memory in your own words: one idea, one clear question, a short answer. Check it against the source. Start with about 20 cards, review them on a spaced schedule, and treat AI-generated cards as a draft to check.

Flashcards work because they make you *retrieve* an answer from memory instead of just recognizing it on the page. The hard part is getting from a 40-page PDF to a set of cards that are actually worth studying. This guide covers what makes a good card, a method for making them, and how to treat cards that a tool generates for you.

Why flashcards help

Rereading feels productive because the material looks familiar, but familiarity is not the same as being able to recall something when you need it. Testing yourself, known as retrieval practice, builds memory better than rereading for the same amount of time. The guide to active recall vs rereading covers the research.

Flashcards are a simple way to do retrieval practice: the front asks, you answer from memory, then you check. Used repeatedly over days and weeks, they also let you spend more time on the cards you keep missing and less on the ones you know.

They are not the right tool for everything. Flashcards are good for facts, definitions, terms, formulas and short relationships. They are weaker for deep understanding of a process or an argument, where working through problems or explaining an idea in your own words does more.

What a good card looks like

Most bad flashcards fail in the same few ways. A good card is:

- **One idea.** "List the stages of mitosis and what happens in each" is a card you will skip. Split it into one card per stage.
- **A clear question.** The front should have one correct answer. "Mitochondria?" is vague. "Which organelle produces most of a cell's ATP?" is not.

- **In your own words.** Copying a sentence from a slide trains you to recognize that sentence, not to understand the idea.
- **Short.** If the answer takes a paragraph, the card is really a topic. Break it up.

A few formats are worth knowing:

Format	Example	Good for
Question and answer	"What does a primary key do?" / "Uniquely identifies each row in a table."	Definitions and concepts
Fill in the blank (cloze)	"The {{blank}} carries oxygen in the blood." / "hemoglobin"	Terms inside a sentence
Term and meaning	"Opportunity cost" / "What you give up when you choose one option over another."	Vocabulary
Formula and use	"When do you use a t-test?" / "To compare means when the sample is small and the population variance is unknown."	Methods and formulas

A method for PDFs and lecture notes

1. Skim first. Read the headings and summaries before you make any cards. You want to know what matters before you decide what to memorize.

2. Pick the ideas worth a card. For each section, ask: "If this came up in the exam, what would I need to recall?" Terms, definitions, key facts and distinctions usually qualify. Background detail and examples usually don't.

3. Write the card from memory. Close the PDF, write the question, then the answer in your own words. Then check it against the source. This step is slower than copying, and it is where most of the learning happens.

4. Add a source note. A page number or week on the back of the card makes it easy to go back when an answer looks wrong.

5. Start small. Twenty good cards from a chapter beat two hundred cards you never review. You can always add more.

6. Review on a schedule. Short, frequent sessions beat one long one. A spaced repetition system, such as Anki or the Flashcards tab in Atheneum, schedules the cards for you, showing the ones you miss more often and the ones you know less often.

Using AI to generate cards

Generating flashcards automatically from a document saves the most time on step 3, and it can be a good way to get a first draft. It also has real limits:

- **AI makes mistakes.** A generated card can state something false with complete confidence, pick the wrong detail, or misread a diagram or table. A wrong card is worse than no card, because you will memorize it.
- **It can't tell what your exam covers.** It works from the document alone. You know what your course emphasizes.
- **Generated cards can be too long or too broad.** You may need to split or shorten them.

So treat the output as a draft, not a finished deck. Before you study a generated set:

1. Read every card once against your source.
2. Delete cards that are vague, trivial, or wrong.
3. Rewrite awkward ones in your own words.
4. Split any card that holds more than one idea.

That review pass is also a useful first round of studying.

Doing this in Atheneum

In Atheneum, the Review tool has a Flashcards tab. You can:

- **Generate a deck** from a notebook's files. The deck is saved, so you can come back to it.
- **Import a deck from Anki.** Export your deck from Anki as text (File → Export, in a tab- or comma-separated format) and import it. Imports come in as plain text, so Anki formatting is not kept, and a single import is limited to 500 cards.
- **Study it with spaced repetition.** Flip each card, then rate yourself Again, Hard, Good or Easy. Each card gets its own due date based on your rating, so the ones you miss come back sooner.
- **Export a deck back to Anki** at any time.

There is also a quicker one-off option: you can generate flashcards from a single file and download them as a text file to import into Anki, without saving a deck in Atheneum.

Studying, importing and exporting decks is free on every plan. Generating a deck uses AI credits: the free plan includes a small monthly allowance on a lighter model, and Pro adds the strongest model and a bigger allowance. Generated cards come from an AI model, which can be wrong, so check them against your material as described above. The features page explains how notebooks and the review tools fit together, the documentation covers uploading files and the Flashcards tab, and the pricing page shows how many AI credits each plan includes.

If you want a place to keep the source files that your cards come from, organizing your notes by subject makes it easy to find the right page when a card needs fixing. Once you have a deck, blurting is a good companion: flashcards drill the small facts, and a blurt shows you how well the facts fit together.

A quick start

1. Pick one chapter or lecture from the subject you most need to revise.

2. Make 15 to 20 cards, each with one idea and a clear question, written in your own words.
3. Review them the next day, then again two or three days later.
4. After a week, delete or rewrite any card you keep getting wrong because it was unclear.

Good cards are small, specific and yours. The deck doesn't have to be big to be useful.

Read next: how to make good flashcards, on writing cards that are easy to review.

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Online: atheneum.app/guides/turn-pdfs-into-flashcards · Updated 2026-10-23

GUIDE 4 · MEMORY · 7 MIN READ

Spaced Repetition for Students: A Practical Intro

What spaced repetition is, why spreading out your reviews helps you remember, and how to start with flashcards without being buried by daily reviews.

THE SHORT ANSWER

Spaced repetition means reviewing material at increasing intervals instead of all at once, with gaps that grow as you remember it better. Research on the spacing effect finds that, for the same total study time, spreading reviews out leads to better long-term memory than cramming. Start with 10 to 20 flashcards and review what is due daily.

Most students study the way they were taught to cram: a lot, all at once, close to the exam. Spaced repetition is the opposite. You review something a little at a time, with gaps that get longer as you get better at remembering it. This guide explains the idea, shows how a schedule works, and gives you a simple way to start.

What spaced repetition is

Spaced repetition means reviewing material at increasing intervals instead of all in one go. You see a fact today, again tomorrow, again in a few days, then in a week or two, and so on. If you remember it easily, the gap grows. If you forget it, the gap shrinks and you see it sooner.

It is usually done with flashcards, because a card is a convenient unit to schedule: each one can have its own review date. But the idea applies to anything you want to remember, not only cards.

Why it works

Memory fades over time unless you use it. Research on learning has long found a **spacing effect**: for the same total study time, spreading reviews out over days or weeks leads to better long-term memory than packing them into one session. Cramming can get you through tomorrow's test, but much of it is gone a week later.

The second ingredient is **retrieval**. Each review asks you to recall the answer from memory, which strengthens it more than rereading does (more in active recall vs rereading). Spaced repetition combines the two. It asks you to recall, and it asks you to do so just as the memory is starting to fade, which is when recalling it does the most good.

It is worth being honest about the limits. Spacing and retrieval are among the best-supported ideas in the research on learning, but the specific intervals any app uses are practical rules of thumb, not scientific constants. Treat a schedule as a sensible default.

How a schedule works

Here is how the Flashcards tab in Atheneum schedules a new card, which is a simplified version of the approach used by Anki and based on an older algorithm called SM-2. If you answer "Good" every time, the card comes back after roughly:

Review	Gap until the next one
1st	1 day
2nd	3 days
3rd	about 1 week
4th	about 3 weeks
5th	about 7 weeks

After a handful of reviews, a card that once needed daily attention shows up only a few times a term. That is the payoff: you keep a lot in memory with a small amount of daily effort.

Your rating changes the schedule:

- **Again** means you did not remember it. The card comes back in about ten minutes and its progress restarts, so it starts again from short gaps. It is also marked as a harder card, so its gaps will grow more slowly later.
- **Hard** means you got it, but only just. The gap grows only a little, and the card is marked as harder.
- **Good** means you remembered it with a normal amount of effort. The gap grows steadily.
- **Easy** means it was effortless. The gap jumps further, and the card is marked as easier.

Each card has its own schedule, so a deck is always a mix: some cards due today, most not due for a while.

Rating yourself honestly

The method only works if your ratings are honest. The most common mistake is rating a card "Good" because you recognized the answer when you saw it. Rate it on whether you could have produced it **before** you flipped the card.

A simple test: if you hesitated, guessed, or only remembered part of it, that is "Hard" or "Again", not "Good". A card that you mark too leniently comes back too late, and you will forget it in between.

How to start

Start small. Begin with 10 to 20 cards from material you have already studied. A big deck on day one creates a big review pile a few days later.

Review a little every day. Ten minutes daily beats an hour once a week. Regular short sessions keep the pile from growing, and they fit easily into the gaps in your day, such as before a lecture or on a commute.

Add new cards at a steady pace. Every card you add comes back for review many times. Adding twenty a day for a week means a lot of reviews in the weeks that follow. Pick a number you can sustain, and stick to it.

Do not skip days if you can help it. Missed reviews pile up. If you do fall behind, do not try to clear everything in one go. Do a manageable batch, then continue as normal, and the pile will shrink.

Start early. Spacing needs time. A deck you begin three weeks before an exam gets many reviews. One you begin the night before gets one.

Making cards that suit it

Spaced repetition is only as good as the cards. A vague or overloaded card is hard to rate honestly and easy to forget. Keep each card to one idea, ask a clear question, and write the answer in your own words. The guide to turning PDFs and lecture notes into flashcards covers this in detail.

Common mistakes

- **Using it for everything.** Spaced repetition suits facts, terms, definitions, formulas and short relationships. It is a poor fit for understanding an argument or solving problems, where practice and explanation matter more.
- **Memorizing without understanding.** A card can be remembered without being understood. Pair your reviews with blurting or explaining topics in your own words.
- **Treating the number as a goal.** Reviews cleared is a measure of effort, not learning. A smaller, well-written deck you review honestly beats a huge one you rush through.
- **Starting with other people's cards without checking them.** Cards you write or edit yourself are usually better than ones you inherit, because the writing is part of the learning.

Doing this in Atheneum

The Review tool has a Flashcards tab for exactly this. You can generate a deck from a notebook's files, or import one from an Anki export (File → Export in Anki, as tab- or comma-separated text; imports are plain text, so Anki formatting is not kept). Each deck in the list shows how many cards are due, with a Study button, and once you have finished it says you are all caught up.

In study mode you flip a card and rate it Again, Hard, Good or Easy (on a keyboard: Space flips, 1 to 4 rate), and the app sets that card's next due date as described above. Review's front page also gathers every card that is due across your notebooks, so you can clear them in one session. You can export a deck back to Anki at any time.

Studying, importing and exporting decks is free on every plan. Generating a deck uses AI credits: the free plan includes a small monthly allowance on a lighter model, and Pro adds the strongest model and a bigger allowance. Generated cards come from an AI model, which can be wrong, so read them against

your material before you start studying them. The features page shows how Review fits with the rest of the workspace, the documentation covers the Flashcards tab, and the pricing page shows which plan includes it.

If you work in short sessions, a daily review pairs well with the Pomodoro technique: a single 25-minute block is more than enough for a day's reviews.

Once you can handle each topic on its own, mixing related topics in the same session helps too. The interleaving guide explains why.

A quick start

1. Pick one topic you have already studied and make 10 to 20 cards.
2. Review them once today, rating each one honestly before you flip it.
3. Come back tomorrow and review whatever is due, then do the same each day.
4. After a week, add a few new cards at a pace you can keep up, and drop or rewrite any card you keep getting wrong because it was unclear.

Small, regular sessions are the whole method. The schedule does the planning, and you only have to show up.

Read next: how to make good flashcards, and how to memorize for med school if you're studying at that volume.

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Online: atheneum.app/guides/spaced-repetition-for-students · Updated 2026-10-23

GUIDE 5 · FOCUS · 5 MIN READ

Pomodoro Technique for Studying: A Practical Guide

How the Pomodoro Technique works for studying: running a session, choosing block lengths, and the common mistakes that make it stop working.

THE SHORT ANSWER

The Pomodoro Technique means studying in timed blocks: pick one task, work on only that for 25 minutes, take a 5-minute break, and after four blocks take a longer break of 15 to 30 minutes. Decide what each block should finish. The 25/5 split is a convention, not a rule, so lengthen or shorten blocks to suit you.

The Pomodoro Technique is a way of working in short, timed blocks with a break after each one. It is popular with students because it is easy to start: you need a timer and a task, nothing else. This guide covers how it works, how to adapt it to studying, and where it tends to go wrong.

What the Pomodoro Technique is

Francesco Cirillo developed the method in the late 1980s while he was a university student, using a tomato-shaped kitchen timer — *pomodoro* is Italian for tomato. The core idea is **timeboxing**: you decide in advance how long you will work on one thing, and you protect that block from interruptions.

The classic version looks like this:

1. Pick one task.
2. Set a timer for 25 minutes and work on only that task.
3. When the timer rings, take a 5-minute break.
4. After four blocks, take a longer break, usually 15 to 30 minutes.

Each 25-minute block is one "pomodoro".

Why it can help when you study

Studying is hard to start and easy to drift out of. The technique helps in a few practical ways:

- **A small start.** "Study for three hours" is vague and heavy. "Work on this chapter until the timer rings" is easy to begin.
- **Fewer interruptions.** Knowing a break is coming makes it easier to leave your phone alone for a short stretch.
- **A visible measure of effort.** Counting blocks tells you how much focused work you did, which is more honest than counting hours spent near a desk.

- **Built-in rests.** Regular breaks keep you from grinding on past the point where you are absorbing anything.

It is worth being honest about the evidence: the general ideas (working in focused blocks, taking breaks) are sensible, but the specific 25/5 numbers are a convention, not a scientific constant. Treat them as a starting point.

How to run a study session

Before the first block, decide what "done" looks like. Write one line for each block: "Read section 3 and write five questions", not "work on biology". A block with a concrete target is much easier to focus on.

During the block, keep a scrap of paper nearby. When a distracting thought arrives ("email Sam", "look up that actor"), write it down and go back to work. You deal with the list in your break.

If you finish early, keep going. Use the remaining time to review what you just did — recall it from memory, then check. Stopping the instant the work is done wastes the block.

If you are interrupted, decide quickly. A short interruption you can handle in seconds is fine. If it is going to take a while, stop the block, deal with it, and start a fresh one. Don't count a half-block as a full one.

Take the break for real. Stand up, stretch, drink some water, look out of a window. Scrolling on your phone doesn't rest the part of you that was just concentrating, and it is hard to stop at five minutes.

How long should a block be?

Twenty-five minutes suits many people, but it is not right for everyone or for every kind of work.

Situation	Try
You struggle to start at all	10 to 15 minutes, to lower the barrier
Reading, problem sets, writing	25 to 50 minutes with a 5 to 10 minute break
You keep getting pulled out of deep work at 25 minutes	Extend to 40 to 50 minutes
Low-energy day	Shorter blocks, more frequent breaks

A simple way to tune it: if you often reach the end of a block wanting to keep going, lengthen it. If you regularly lose focus before the timer rings, shorten it.

Common mistakes

- **Planning no task.** Starting a timer without a target just gives you a timed version of drifting.
- **Multitasking inside the block.** One block, one task. Checking messages "quickly" breaks the point of it.

- **Skipping breaks because you feel fine.** Feeling fine is when the break is cheap. Skipping them is how a productive morning turns into a wasted afternoon.
- **Using it for everything.** Some things don't fit: a lab with a fixed schedule, a discussion, a group call. Use the technique where you control your own time.
- **Chasing the count.** The number of blocks is a rough guide, not a score. A day of three good blocks beats eight distracted ones.

Doing this in Atheneum

Atheneum has a focus timer with adjustable work and break lengths, so you can use the standard 25/5 or set your own. It works in the browser without an account. If you sign in, your sessions are saved and count toward your streak and badges, and the first few each day also earn points.

To go beyond timing, pair it with the rest of your study setup: keep the material for the session in a notebook, and use the break to note what to review next. The features page shows how the tools fit together, and the documentation explains each one.

If the hard part is starting at all, the guide to beating procrastination has ways to make the first block easier.

What you do inside each block matters as much as the timer. Spending a block on recall instead of rereading gets more from the same 25 minutes, and a plan such as an exam revision timetable tells you what each block is for.

A quick start

1. Pick one subject and one specific task for your first block.
2. Run three blocks of 25 minutes with 5-minute breaks, then take a longer break.
3. After each block, write one sentence on what you got done.
4. At the end of the week, look at which block length felt best and adjust.

The technique is a tool for getting started and staying on task. If a different rhythm works better for you, use that — the goal is focused time, not following the method exactly.

Read next: taking breaks while studying on what to do in the breaks, music while studying, and phones and studying.

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Online: atheneum.app/guides/pomodoro-technique-for-studying · Updated 2026-10-23

GUIDE 6 · ORGANIZATION · 5 MIN READ

How to Organize Study Notes by Subject

A simple system for organizing study notes and course files: one home per subject, a consistent folder layout, clear file names, and a weekly tidy-up.

THE SHORT ANSWER

Give each subject one home that holds everything for it, then use the same shallow layout inside each, usually one folder per week or unit. Name files so they sort themselves, such as Week 03 – Lecture – Metabolism, keep source material apart from your own notes, and spend about 15 minutes a week filing and renaming.

Most students don't have a notes problem. They have a *finding* problem: the lecture slides are in one folder, the notes are in a notebook app, the readings are in downloads, and nothing is named in a way that helps at 11pm before an exam. A small amount of structure, set up once, fixes most of this.

This guide gives you a system that works on paper, in a notes app, or in a file vault, and takes about an hour to set up.

Principle 1: one home per subject

Give each subject or course a single place where everything about it lives: slides, readings, your own notes, practice questions, past papers. Whether that is a physical binder, a folder on your computer, or a notebook in an app doesn't matter. What matters is that when you think "organic chemistry", you know exactly one place to open.

The most common failure is splitting by *type* instead of by subject ("all my PDFs", "all my handwritten notes"). Type-based piles look tidy but mean you open four places to study one topic.

Principle 2: a layout you can repeat

Inside each subject, use the same structure every time, so you never have to think about where something goes. A reliable default is to organize by **unit or week**:

```
Biology 101
  Week 01 – Cells
  Week 02 – Membranes
  Week 03 – Metabolism
  Exams
  Assignments
```

Organize by the way the course is taught. If your lecturer teaches in weeks, use weeks. If the syllabus is split into units or chapters, use those. Matching the course structure means the syllabus doubles as your table of contents.

Keep it shallow. Two levels (subject, then unit) is enough for almost everyone. Deep nesting takes longer to maintain than it saves in searching.

Principle 3: name things so they sort themselves

A file called `notes_final_v2.docx` tells you nothing in a month. Pick one naming pattern and use it everywhere:

```
Week 03 – Lecture – Metabolism

Week 03 – Reading – Chapter 5

Week 03 – My notes
```

Putting the week or unit number first means files sort in the order you'll study them. Putting the *type* second lets you see at a glance what you have for each week. Zero-pad numbers (`01`, `02`, … `10`) so that week 10 doesn't sort before week 2.

Principle 4: keep source material and your own notes apart

Slides, articles and textbook chapters are **source material**. Your summaries, questions and diagrams are **your notes**. Keep them in clearly separate places, even if they live in the same subject.

The reason is simple: your own words are what you'll actually learn from, and you need to be able to find them without wading through twenty PDFs. Source material is something you return to for detail.

Principle 5: write notes you can test yourself with

Organizing isn't only about filing. How you write also matters. Two habits make notes far more useful at revision time:

- **Write questions, not just statements.** Next to a key point, write the question it answers. Covering the answer and recalling it from memory is a much better use of revision time than rereading. The guide to active recall vs rereading explains why.
- **Put the point first.** Start each note with a one-line summary of what it covers. When you skim later, those lines are your index.

A weekly tidy-up

Systems decay unless you maintain them. Once a week, for about 15 minutes:

1. Move anything still sitting in a catch-all inbox or downloads folder into its subject.

2. Rename any file that doesn't follow your pattern.
3. Skim this week's notes and add a one-line summary to any that lack one.
4. Write down the two or three things you'd need to review first next week.

If this feels like a lot, do only step 1. Getting files into the right home is the part that matters most.

Common mistakes

- **Building the perfect system before starting.** A simple structure you use beats an elaborate one you abandon. Set it up, use it for two weeks, and adjust.
- **Too many folders.** If a folder holds one file, it probably doesn't need to exist.
- **Saving everything.** Not every slide deck deserves a place. Keep what you'll actually use.
- **Different rules for different subjects.** The value comes from the consistency. Use the same layout and naming across all your courses.

Doing this in Atheneum

Atheneum's Notebooks follow this pattern. You keep a notebook for each subject and upload PDF and DOCX files into it, and notebooks can hold folders so you can mirror your weekly or unit structure. You can open the features page to see how Notebooks fit with the rest of the workspace, and the documentation walks through uploading and organizing files.

If you study in short, focused blocks, the Pomodoro guide pairs well with this: a clear folder for the subject means you can sit down, open one place, and start the timer.

For what to write in those notes in the first place, see how to take lecture notes. If you revise with classmates, a notebook can be shared so the group's material lives in one place, as the study group guide describes.

A quick start

1. List your current subjects and create one home for each.
2. Inside each, create a folder per week or unit that has already happened, plus `Exams` and `Assignments`.
3. Move your existing files in and rename them with the `Week – Type – Topic` pattern.
4. Set a recurring 15-minute slot in your calendar for the weekly tidy-up.

An hour of setup now saves you from searching when it counts.

Read next: how to study for an open-book exam, where notes you can search fast matter most.

Sources

This guide is practical advice rather than a summary of research, so it makes no claims that need a citation. The study methods it points to are sourced in their own guides.

Online: atheneum.app/guides/how-to-organize-study-notes · Updated 2026-10-24

GUIDE 7 · EXAMS · 6 MIN READ

How to Build an Exam Revision Timetable That Works

A step-by-step method for planning exam revision: work backwards from the exam date, rank your topics, schedule real sessions, and adjust when you fall behind.

THE SHORT ANSWER

Work backwards from the exam date: count your real study days, keep the last day or two for light review and rest, and leave buffer sessions. Rate every topic red, amber or green by testing yourself, then schedule short sessions for red topics first, each with one topic, a method and a finish line. Review the plan every few days.

A good revision timetable does one job: it turns "I have an exam in three weeks" into "here is what I do today". A bad one looks neat, takes an evening to color-code, and is abandoned by Thursday. This guide shows how to build the first kind, using a simple method you can do on paper or in any calendar.

Start from the exam date and work backwards

Planning forward ("I'll start with chapter one and see how far I get") nearly always runs out of time. Plan backwards instead:

1. **Write down the exam date** and count the days you actually have.
2. **Mark the days you cannot study.** Lectures, work, travel, sport, family. What remains is your real time, and it is usually less than you think.
3. **Reserve the last day or two** for light review only, and the day before for rest and sleep. New material at that point causes panic, not learning.
4. **Add a buffer.** Keep one or two empty sessions a week for the topics that take longer than planned.

What is left is the time you can actually fill.

Audit your topics before you plan

You cannot split your time sensibly until you know where you stand. List every topic the exam covers, using the syllabus or lecture list, and rate each one honestly:

- **Red:** I could not explain this.
- **Amber:** I understand some of it, but I would struggle on a question.
- **Green:** I could answer a question on this now.

The quickest honest test is to try to recall it with your notes closed. A blurt of each topic, or a few practice questions, will show you the real color far better than rereading will.

Then give your time to the topics in this order: red first, then amber, with green topics getting only short reviews to keep them fresh. Most people do the opposite, spending hours on topics they already like and know.

Estimate, then allocate

For each red and amber topic, estimate how many study sessions it needs. A session of 25 to 50 minutes is a good unit. Be a little pessimistic, because new material usually takes longer than you expect.

If the total comes to more sessions than you have, do not squeeze your estimate. Cut instead. Look at how the topics are weighted in the exam, or which ones appear most in past papers, and drop or shorten the least valuable ones. It is better to know most of the exam well than to skim all of it.

Fill in real sessions, not vague blocks

"Revise biology, 2 to 5pm" is not a plan. "Cells: blurt, fix gaps, then 15 flashcards" is. For each session, write three things:

- **The topic** (one, not several)
- **The method** (what you will do)
- **The finish line** (how you will know you are done)

Mix your methods across the week. Reading is fine for a first pass, but most of your time should go on recall: blurting, practice questions, and flashcards reviewed on a spaced schedule. Revisit each topic a few days after you first cover it, so it is not a single pass.

Keep each session short enough to stay focused. The Pomodoro technique is a good fit: a block, a break, another block.

A two-week example

Here is a simple plan for an exam in two weeks with three subjects. You will have your own days and topics, but the shape holds:

Days	Focus	Methods
1 to 2	Audit all three subjects, rate every topic red, amber or green	Blurts, past-paper questions
3 to 9	Red topics first, then amber, about two sessions a day	Study, blurt, add flashcards
10	Buffer day: catch up on anything that slipped	Whatever fell behind
11 to 12	Practice under timed conditions	Past papers, then mark and fix gaps
13	Light review of weak spots and key facts	Flashcards, short blurts
14 (day before)	Rest, a short skim, early night	Almost nothing

Notice that every week has a built-in catch-up slot, and the plan ends with rest, not cramming.

Review the plan every few days

A timetable is a guess that you improve as you go. Every few days, take five minutes to check:

- What did I actually finish?
- Which topics are still red?
- What do I need to move or drop?

If you fell behind, do not try to double up tomorrow. Move the missed session into your buffer, and if there is no room, drop the lowest-value topic. A plan you adjust beats a plan you abandon.

Common mistakes

- **Planning too much.** Eight-hour days look impressive and fall apart. Plan the amount you will really do, and treat anything extra as a bonus.
- **A beautiful timetable and no recall.** Color-coding and rewriting notes feel productive but are not studying. Spend the time on retrieval.
- **Only studying what you like.** Start with the red topics while you have time to fix them.
- **No buffer or rest.** Plans without slack collapse the first time something goes wrong. Sleep is part of revision, not a break from it.
- **Putting it off.** The plan only helps if the first session happens. Start with the first small session today.

Doing this in Atheneum

You can build the timetable out of tools you already use:

- **Calendar.** Add your exam as an event and mark it as an exam, and mark assignments as deadlines, which are styled distinctly. You can set a reminder time before each one. Your revision sessions can go in as events, and you can connect Google Calendar in Settings if you want them mirrored there. The calendar needs you to be signed in.
- **Tasks.** The task board is a kanban board with columns you can move cards between. Make a card for each session or topic, and drag it across as you go. It works without an account.
- **Pomodoro timer.** Run each session as a focus block with the built-in timer. Sign in and your sessions are saved and count toward your streak and badges, and the first few each day also earn points.
- **Athena, the tutor.** The Review page has a shortcut that opens a chat with an exam-plan request pre-filled; it works on every plan and uses a few AI credits. Fill in your exam date, hours per day and topics, and Athena will propose a day-by-day plan. It is a draft, not a finished plan, since it comes from a language model that can be wrong. Check it against your own audit, then put the sessions into your calendar and task board yourself.

The features page shows how these tools fit together, and the documentation covers the calendar, the task board and the timer. The pricing page shows how many AI credits each plan includes.

In the final weeks, mix topics within each session rather than revising one at a time; the interleaving guide explains why that matches how exam papers test you.

A quick start

1. Write down your exam date and count the study days you really have.
2. List every topic and rate it red, amber or green after a quick blurt.
3. Plan backwards: reserve the last days, add a buffer, then fill in sessions for red topics first.
4. Put the sessions in your calendar or task board, and do the first one today.

You will get more out of an imperfect plan that you follow than a perfect one that you do not.

Read next: how to use past papers, for the last weeks of the plan, how to study for finals in a week if you're starting late, and how to study for multiple-choice exams.

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Online: atheneum.app/guides/exam-revision-timetable · Updated 2026-10-23

GUIDE 8 · UNDERSTANDING · 5 MIN READ

The Feynman Technique: Learn by Explaining It Simply

How to use the Feynman Technique to find the gaps in your understanding: explain a topic in plain words, spot where you get stuck, and go back to the source.

THE SHORT ANSWER

Explain one narrow topic in plain words, as if to a beginner, and the places where you stumble show you what to study next. Write the explanation with one concrete example, mark every spot where you got stuck or used jargon you can't define, check only those spots in your notes, then explain it again more simply.

You can read a chapter, follow every step, and still not understand it. The problem only shows up later, when a question asks you to use the idea instead of recognize it. The Feynman Technique is a quick way to find that problem early: you try to explain the topic in plain words, and the places where you stumble show you exactly what to study next.

What the Feynman Technique is

The method is named after Richard Feynman, the physicist known for explaining hard ideas in simple language. He never published it as a four-step method. The version students use today was put together later from stories about how he worked.

Preparing for his graduate exams, he started a notebook titled "Notebook of Things I Don't Know About" and worked through physics looking for the gaps. Years later, when a colleague asked him to explain a hard result, he set out to prepare a lecture a first-year student could follow, came back unable to do it, and concluded that this meant "we really don't understand it". Explaining simply, and treating the places you can't as gaps, is the idea the technique is built on.

The usual version has four steps:

1. **Pick a topic** and write its name at the top of a blank page.
2. **Explain it in plain words**, as if to someone who has never studied it: a younger student, or a friend from a different course.
3. **Find the gaps.** Wherever you got stuck, waved your hands, or fell back on jargon you couldn't define, mark it.
4. **Go back to the source**, fill the gaps, and explain it again, more simply.

Why it works

The technique combines two things that help learning.

- **It is active recall.** You build the explanation from memory, not by copying it out of your notes. Pulling information out of memory is one of the most reliable ways to strengthen it. The active recall guide covers the research.
- **It tests understanding, not just memory.** Reciting a definition and explaining it are different things. To explain *why* something happens, you have to connect the pieces, and missing connections become obvious when you try.

It is also honest. Rereading feels productive because the page looks familiar. A blank page doesn't let you fool yourself.

How to do it, step by step

Choose a narrow topic. "Thermodynamics" is too big for one page. "Why a gas cools when it expands quickly" is about right. If your explanation runs past a page, split the topic.

Write, don't just think. Saying an explanation in your head lets you skip the hard parts. Writing it, or saying it out loud to an empty room, makes you commit to each step.

Ban the jargon you can't define. Technical terms are fine *if* you can explain them. If you write "because of entropy" and then can't say what entropy means here, that's a gap.

Use an example. A good explanation usually includes one concrete case: numbers, a picture, a real situation. If you can't come up with one, that is useful to know.

Mark the gaps clearly. Underline or highlight every spot where you hesitated, guessed, or wrote something vague. These marks are the point of the exercise.

Go back to the material for the gaps only. Don't reread the whole chapter. Look up exactly what you marked, then close the source again.

Explain it again, shorter. A second, simpler explanation is the test that you've closed the gaps. If you can now explain it in a few sentences without notes, move on.

An example

Say the topic is "why the transport layer needs port numbers".

A first attempt might read: *"The network layer sends packets to the right computer. Ports make sure the data goes to the right… place. Because there are many connections."*

The gap is obvious: "the right place" is vague. Going back to the notes fills it in: the network layer gets a packet to the right *machine*, but a machine runs many programs at once, and a port number tells the operating system which *program* should receive it.

The second attempt: *"An IP address gets data to the right computer. A port number gets it to the right program on that computer, like an apartment number after a street address."*

Common mistakes

- **Picking a topic that's too broad.** You'll write a vague summary instead of a real explanation.
- **Explaining to yourself instead of a beginner.** If your imagined listener already knows the subject, you'll skip the steps that matter.
- **Skipping the gap-finding step.** Writing an explanation feels like the work, but finding where it breaks is where the learning happens.
- **Copying the textbook's wording.** If your explanation sounds like the book, you may be recalling sentences rather than understanding them.

Doing this in Atheneum

Atheneum's Notes tool is a quick place to write your explanation without creating a file. Keep your lecture material in a notebook so you can go straight to the source when you mark a gap.

Athena, the AI tutor, can play the beginner. Ask her to read your explanation and point out where it's unclear or wrong, using the files in your notebook. Treat her feedback as a lead to check against your material, not the final word. The guide on studying with an AI tutor covers how to do that well.

Blurting is a close cousin. It recalls *everything* about a topic, while Feynman explains *one* idea in depth, and they work well together.

A quick start

1. Pick one idea from this week's lectures that you think you understand.
2. Explain it on one page, in plain words, with one example.
3. Mark every vague or stuck spot, then check only those in your notes.
4. Explain it again in five sentences or fewer.

If the second explanation comes easily, you understand it. If not, you've found exactly what to study next.

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Online: atheneum.app/guides/feynman-technique-for-studying · Updated 2026-10-23

GUIDE 9 · MEMORY · 4 MIN READ

Interleaving: Why Mixing Topics Helps You Learn

What interleaved practice is, why mixing problem types beats practicing one at a time, and how to build mixed practice into your revision without getting lost.

THE SHORT ANSWER

Interleaving means mixing related topics or problem types in one practice session instead of doing each in a block, so every question starts with deciding which method it needs, just as on an exam. In math studies, students who practiced mixed problems did better on later tests, despite more mistakes during practice. Learn each type first, then shuffle.

Most textbooks teach one thing at a time: a chapter on one method, then twenty problems that all use it. That is a sensible way to *introduce* a topic, but it is a weak way to *practice* one. **Interleaving** means mixing different topics or problem types in the same session, so you have to work out which approach each question needs. It feels harder, and that is part of why it works.

Blocked versus interleaved practice

Say you're revising three kinds of calculus problem: A, B and C.

- **Blocked practice:** AAAAA, then BBBBB, then CCCCC.
- **Interleaved practice:** A, C, B, B, A, C, B, A, C…

In blocked practice you already know which method to use before you read the question, because it's the same as the last one. In interleaved practice, every question starts with a decision: *what kind of problem is this?* That decision is exactly what an exam asks of you, since exam questions don't come labeled with the chapter they're from.

What the research says

Interleaving is one of the better-studied learning techniques, especially in maths and in learning to tell categories apart.

- In maths, students who practiced mixed problem sets have done better on later tests than students who practiced the same problems in blocks, even though they made more mistakes during practice.
- In a well-known study by Kornell and Bjork (2008), people learned to recognize painters' styles better when paintings by different artists were mixed together than when they saw each artist's work in a block. Most participants still *believed* blocking had worked better.

That last point is common. Interleaving feels slower and less fluent while you're doing it, so it's easy to conclude it isn't working. The benefit shows up later, on the test.

Interleaving isn't magic. It helps most when the topics are related enough to be confused with each other (similar problem types, similar concepts), and it helps less when you are meeting a topic for the very first time.

Why it works

- **You practice choosing the method**, not just carrying it out. Blocked practice skips this step entirely.
- **You notice differences.** Seeing two similar problem types side by side makes you pay attention to what separates them.
- **It spaces your practice naturally.** Coming back to topic A after B and C puts a gap between attempts, which helps memory. See the spaced repetition guide.

How to interleave your revision

Learn first, then mix. When a topic is brand new, a short block of practice on just that topic is fine. Interleave once you can do each type on its own.

Mix within a subject, not across unrelated ones. Alternating calculus and French vocabulary isn't really interleaving. Mixing three kinds of integration problem is.

Shuffle your questions. Take the end-of-chapter problems from the last three chapters and do them in a random order. Cover the chapter headings so you can't see which section a question came from.

Ask "what kind of problem is this?" first. Before solving anything, name the approach you'll use. If you get it wrong, that's the most useful mistake you can make in revision.

Use past papers. Exam papers are already interleaved. Doing full papers, or sections of them, is interleaving practice built for you.

Expect it to feel harder. More mistakes during mixed practice is normal. Judge the method by how you do a week later, not by how smooth the session felt.

Common mistakes

- **Interleaving too early.** If you can't yet do each problem type alone, mixing them just adds confusion.
- **Mixing topics that are too different.** The benefit comes from telling similar things apart.
- **Giving up because it feels slow.** The difficulty is the point.
- **Never checking which type you got wrong.** Keep a note of which problem types you confuse, and practice those pairs side by side.

Doing this in Atheneum

In Review, quizzes can be generated across a whole notebook rather than a single file. They draw on everything in the notebook, so questions from different lectures come mixed together, much like an exam. You choose the difficulty and how many questions, and the results show your weakest topics so you know which types to practice next.

A flashcard deck generated from a whole notebook covers several lectures at once, so one review session can mix topics too. Keep each subject's files together in one notebook so mixed practice stays within the subject.

A quick start

1. Pick three related topics or problem types you've already learned.
2. Collect five questions on each and shuffle them into one list of fifteen.
3. Before each one, write down which method you'll use, then solve it.
4. Note which types you mixed up, and next session put those two side by side.

Mixed practice is harder in the moment and better on the day. That trade is worth making.

Read next: how to study for a math exam, and how to study for a test the day before.

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Online: atheneum.app/guides/interleaving-for-studying · Updated 2026-10-23

GUIDE 10 · ORGANIZATION · 5 MIN READ

How to Take Lecture Notes You'll Actually Use

How to take lecture notes that help you revise: prepare before the lecture, capture structure not transcripts, use the Cornell layout, and review within a day.

THE SHORT ANSWER

Note what the slides don't have: explanations of why, worked examples, links between ideas and hints about what matters, in your own words and with space left. Skim the slides for ten minutes beforehand. The same day, fill the gaps, add questions in a margin and a short summary, then answer the questions with your notes covered.

Lecture notes have one job: to help future you understand and revise the material. A lot of notes fail at that job. Some are near-transcripts of the slides, too long to reread and too passive to learn from. Others are three cryptic lines that made sense at the time. This guide covers a way of taking notes that sits between the two, and what to do with them afterwards, which matters even more.

Before the lecture: ten minutes of preparation

If the slides or reading are posted in advance, skim them for ten minutes beforehand. You're not trying to learn the material yet, just to see its shape: the main headings, the new terms, the diagrams that look important.

This pays off in the lecture. When you already know the slides exist, you don't need to copy them. You can spend your attention on what the lecturer *says* that isn't on the slides: the explanations, the examples, the "this will come up in the exam" moments.

During the lecture: capture structure, not sentences

Don't transcribe. Writing down everything leaves no attention for understanding it. If the slides are available, you already have the facts. Your notes should add to them.

Write in your own words. Paraphrasing forces you to process what was said. Copying word for word doesn't.

Capture the things the slides don't have:

- Explanations of *why*, not just *what*.
- Examples the lecturer works through.
- Links between ideas ("this is the same idea as last week's…").
- Hints about what matters: emphasis, repetition, mentions of the exam.

- Your own questions and points of confusion.

Use abbreviations and symbols you'll still understand in a month: arrows for "leads to", "?" for something to look up, "!" for something emphasized.

Leave space. Gaps make it easy to add things later, and later is where a lot of the value comes from.

The Cornell layout

The Cornell method is a simple page layout that builds review into your notes. Divide a page into three parts:

Part	Where	What goes in it
Notes	Large right-hand column	What you write during the lecture
Cues	Narrow left-hand column	Questions and keywords, added *after* the lecture
Summary	Strip across the bottom	Two or three sentences summing up the page, added after

The cue column is what makes it work. After the lecture, you write a question in the left column next to each chunk of notes, such as "Why does X happen?" Later, you cover the right side and try to answer the questions from memory. Your notes turn into a self-test. The active recall guide explains why that beats rereading.

You don't have to use Cornell exactly. The principle that matters is this: **leave room to turn your notes into questions.**

After the lecture: the step most people skip

Notes you never look at again do very little. A short review soon after the lecture, ideally the same day, is a good habit: it's your first chance to recall the material rather than just reread it.

1. **Fill the gaps** while the lecture is fresh: finish half-written points and look up anything you marked with "?".
2. **Write the cue questions** and a two-line summary.
3. **Try to answer the questions** with the notes covered.

This takes about 15 minutes per lecture. It turns the notes into something you can revise from, and it shows you early what you didn't understand, instead of three weeks before the exam.

Paper or laptop?

Both can work. A well-known 2014 study found that students taking notes on laptops wrote down more of the lecture word for word and did worse on conceptual questions than students writing by hand. A larger replication in 2019 found the handwriting advantage was much weaker than first reported, so the device

matters less than how you use it. Laptops do make it easy to drift into other tabs, and multitasking in class has been found to hurt learning, both for the person doing it and for students who can see their screen. If you type, the same advice applies: paraphrase, don't transcribe, and close everything except your notes.

Common mistakes

- **Copying the slides.** You already have them. Note what's *not* on them.
- **Never reviewing.** Notes that are only written, never used, give you little.
- **Notes with no structure.** Use headings that match the lecture's sections so you can find things later.
- **Scattering notes everywhere.** One home per subject saves hours at exam time. See the guide on organizing study notes.

Doing this in Atheneum

Upload each lecture's slides or handouts to that subject's notebook. Atheneum writes a structured summary of each file, which is a useful check against your own notes: if the summary covers a point you missed, add it.

Use Notes to catch a thought mid-lecture without creating a file. In Review, you can generate a quiz or a flashcard deck from the notebook, which does the cue-column job for you: questions built from your material, to answer from memory. Check generated questions against the source, especially early on.

A quick start

1. Before your next lecture, skim the slides for ten minutes.
2. In the lecture, write only what isn't on the slides, in your own words, with space left.
3. The same day, add three to five questions in a margin and a two-line summary.
4. Next week, answer those questions with your notes covered before you start the new lecture.

Good notes aren't the longest ones. They're the ones you can test yourself with.

Read next: handwriting vs typing notes, on what the research says about the tool you take notes with.

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Online: atheneum.app/guides/how-to-take-lecture-notes · Updated 2026-10-23

GUIDE 11 · FOCUS · 5 MIN READ

How to Stop Procrastinating and Start Studying

Practical ways to stop putting off studying: make the first step tiny, remove friction, deal with the feeling behind the delay, and build a routine.

THE SHORT ANSWER

Make the first step tiny and specific, like opening the notes for one topic or doing two questions, because carrying on is usually easier than starting. Procrastination is largely about avoiding bad feelings, so lower the stakes: decide when and where you'll study, put your phone out of reach, and set a 10 or 25 minute timer.

Procrastination isn't laziness. Most students who put off studying care about the result, which is part of the problem. Studying feels uncomfortable: it's hard, it's boring, or it reminds you how far behind you are. Avoiding it gives instant relief. The relief doesn't last, the work is still there, and now there's less time.

This guide is about getting from "I should study" to actually studying, using small changes that are easier to act on than willpower.

Why we put off studying

Research on procrastination keeps finding the same thing: it's largely about **managing feelings**, not time. We delay tasks that make us feel anxious, bored, confused or overwhelmed, and we do something that feels better right now instead.

That's useful to know, because it means the fix isn't a better schedule alone. It's making the start of the task feel less bad.

Make the first step tiny

"Revise for the chemistry exam" is a huge, vague task, and vague tasks are easy to avoid. Shrink the start until it feels almost silly:

- "Open the notes for Topic 3."
- "Do the first two questions."
- "Read one page and write one line about it."

Once you've started, carrying on is usually much easier than starting was. The goal of the first step is just to get moving.

Use a timer to lower the stakes

Committing to "study all evening" is daunting. Committing to 25 minutes isn't. A timer sets a clear end point, so the discomfort feels limited, and many people find they want to continue when it rings.

On a really bad day, try 10 minutes. You're allowed to stop after 10. Often you won't. The Pomodoro guide covers how to run timed sessions well.

Remove friction, add it to distractions

Make studying the easy option and distractions the awkward one:

- **Set up the night before.** Notes open, books out, the first task written down.
- **Put your phone in another room**, or at least out of reach and face down. One study found that people did worse on attention tasks with their phone on the desk than with it in another room, though a later replication didn't find the same effect. Either way, a phone you can't reach is one fewer decision to make.
- **Close every tab you don't need** before you start.
- **Study in the same place** if you can. A spot linked with work makes starting more automatic.

Decide when, not just what

"I'll study tomorrow" usually means "I'll decide tomorrow", and tomorrow-you will feel the same reluctance. A specific plan works better: "At 4pm, after lunch, at the library desk, I'll do the first five practice questions." Psychologists call these *implementation intentions*, and they make a follow-through more likely than a general goal does.

A revision timetable is the bigger version of this: it decides in advance what each session is for.

Deal with the feeling, not just the task

If you notice yourself avoiding something, ask what the feeling is.

- **Overwhelmed?** The task is too big. Break it down further.
- **Confused?** You don't know how to start. Make the first step "find out how to start": reread the question, look at a worked example, ask someone.
- **Anxious about being behind?** Look at what you *can* do today, not everything you haven't done. Then do one small piece.
- **Bored?** Make it more active. Test yourself instead of rereading, or set a target such as "ten flashcards in five minutes".

Be kind to yourself about past procrastination. Students who forgive themselves for putting something off tend to procrastinate *less* on the next task than those who beat themselves up about it.

Build a routine that starts itself

The less you have to decide, the less there is to put off. A short study session at the same time each day, even 20 minutes, turns studying into a habit rather than a decision. Spreading your study time across several days also helps memory more than packing the same hours into one session, and it keeps a looming exam from becoming a crisis.

Common mistakes

- **Waiting to feel motivated.** Motivation often comes *after* you start.
- **Making a perfect plan instead of starting.** Planning can be its own kind of procrastination.
- **All-or-nothing thinking.** Twenty minutes of studying beats zero minutes of perfect studying.
- **Rewarding yourself first.** "One episode, then I'll start" rarely ends after one episode.

Doing this in Atheneum

The focus timer works without an account, so a 25-minute (or 10-minute) session is one click away. It keeps running while you move around the app. If you sign in, label the session with what you're working on and your sessions are saved.

Streaks in Atheneum are weekly: studying on one day in a week keeps them going, so a missed day doesn't wipe out your progress, which removes some of the all-or-nothing pressure. Badges reward showing up regularly, and they're optional. You can put the day's first tiny step on the task board the night before, so it's waiting for you.

A quick start

1. Tonight, write tomorrow's first study step. Make it tiny and specific.
2. Decide when and where you'll do it.
3. Put your phone in another room and start a 10-minute timer.
4. When it rings, decide whether to keep going. Either answer is fine.

You don't need to feel ready. You need to start small enough that starting is easy.

Read next: how to build a study habit that sticks, and phones and studying if your phone is where the time goes.

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Online: atheneum.app/guides/how-to-stop-procrastinating-studying · Updated 2026-10-28

GUIDE 12 · AI · 4 MIN READ

How to Study With an AI Tutor (Without Fooling Yourself)

How to use an AI tutor to learn, not just get answers: have it quiz you, review your explanations, check its claims, and follow your course rules.

THE SHORT ANSWER

Use an AI tutor to make yourself recall, not just to read answers. Ask it to quiz you one question at a time, review your own explanations, and give hints instead of solutions. AI models sometimes state false things confidently, so check its claims against your course material, and follow your institution's rules on AI use.

An AI tutor can explain a hard idea five different ways at midnight, quiz you on demand and never get impatient. It can also make studying feel productive while you learn very little, or state something wrong with total confidence. Whether it helps depends almost entirely on how you use it. This guide covers ways of using an AI tutor that build real understanding, and the traps to avoid.

The trap: answers feel like learning

The easiest thing to ask an AI is "what's the answer?" or "explain this to me". You read a clear explanation, it makes sense, and it *feels* like you've learned it.

That feeling is the same one rereading gives you: recognition, not recall. Understanding an explanation while you read it is very different from being able to produce it yourself in an exam. The active recall guide explains why.

The fix is to make the AI do the work a good tutor does: ask questions, check your thinking, and make *you* do the remembering.

Better ways to use an AI tutor

Ask it to quiz you. "Ask me five questions on this lecture, one at a time, and wait for my answer before telling me if I'm right." This turns the AI into a practice partner instead of an answer machine.

Explain first, then ask for feedback. Write your own explanation of a concept, then ask the tutor to find what's missing or wrong. This is the Feynman Technique with a reviewer.

Ask for hints, not solutions. On a problem set, ask "what's the first step?" or "what concept does this question test?" rather than for the worked answer. You learn the method by doing it.

Ask why, not just what. "Why does this work?" and "when would this approach fail?" build the connections exams test.

Ask for a different angle when stuck. If an explanation doesn't click, ask for an analogy, a worked example, or a simpler version. This is where AI tutors really shine.

Ask it to find your weak spots. After a practice quiz, ask which topics your wrong answers have in common, and what to revise first.

Check what it tells you

AI language models sometimes state false things confidently, mix up details, or invent sources that look real. That's a property of how they work, not a rare glitch.

- **Prefer answers grounded in your own material.** A tutor that works from your lecture notes is more likely to match your course than one answering from general knowledge.
- **Check claims against the source.** If it cites a file or page, open it and confirm.
- **Be extra careful with numbers, dates, quotes and references.** These are where errors are most common and most costly.
- **If something contradicts your lecturer, trust your lecturer**, then ask about it in class.

Follow your course's rules

Universities and schools have different rules on AI. Some allow it for studying but not for assessed work. Some require you to declare any use, and some don't allow it at all. Using AI to *learn* your material is very different from using it to *produce* work you submit as your own. Check your institution's policy and your module's assessment rules before relying on AI for anything that's graded.

Common mistakes

- **Reading explanations instead of testing yourself.** Comprehension isn't recall.
- **Copying answers into problem sets.** You skip exactly the practice the problem set exists for.
- **Not verifying.** Treat the AI's claims as leads to check, not facts.
- **Asking vague questions.** "Explain chapter 4" gets a generic summary. "Quiz me on the three conditions in section 4.2" gets useful practice.

Doing this in Atheneum

Atheneum's tutor, Athena, works from the files in your notebooks. Attach files from your notebooks, and she answers from that material and tells you which file she took it from, so you can check it. You can set a tutor profile for difficulty, pace and style (visual, verbal or practical), and drop up to five files into a conversation. She's on every plan, within your monthly AI credits, in the assistant.

Use her the ways above: ask her to quiz you on a lecture, or paste your own explanation and ask what's missing. For structured practice, Review generates quizzes graded against your notes, with feedback on weak topics, and flashcard decks you study with spaced repetition.

Athena can be wrong. The docs explain where and how to check her.

A quick start

1. Choose one lecture you've already been to.
2. Ask your AI tutor to quiz you on it with five questions, one at a time, without giving answers first.
3. For each one you miss, ask *why* the right answer is right, then check that against your notes.
4. Tomorrow, ask for five new questions on the same lecture and see what's changed.

Used like this, an AI tutor makes you do more remembering, not less. That's what makes it worth using.

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Online: atheneum.app/guides/studying-with-an-ai-tutor · Updated 2026-10-23

GUIDE 13 · TOGETHER · 4 MIN READ

How to Run a Study Group That Actually Helps

How to make a study group worth the time: keep it small, prepare first, quiz and teach each other, and keep the group's material in one place.

THE SHORT ANSWER

Keep the group to three to five people who prepare beforehand, meet at a regular time, and set one goal per session. In the session, quiz each other from memory and take turns teaching a topic without notes, since teaching others shows whether you really understand it. Do first-time learning of dense material alone.

A good study group can be the most useful hour of your week: you hear explanations you'd never have come up with, find out what you don't know, and stay on track because other people expect you. A bad one is two hours of chatting, snacks and someone reading the slides aloud. The difference is mostly structure. This guide covers how to set one up so it helps.

When a study group helps, and when it doesn't

Groups are good for:

- **Explaining ideas to each other.** Teaching someone else is one of the best ways to find out whether you understand something.
- **Testing each other.** Being asked questions by another person is active recall with a bit of healthy pressure.
- **Filling gaps.** Someone else may have understood the lecture you didn't.
- **Staying accountable.** A scheduled session is harder to skip than a vague plan to study alone.

They're less good for first-time learning of dense material, or for anything that needs long, quiet concentration, like memorizing or working through hard problems for the first time. Do that alone, and bring the results to the group.

Set it up well

Keep it small. Three to five people is plenty. Bigger groups split into side conversations, and some people stop taking part.

Pick people who'll prepare. Friendship helps, but a group works best when everyone turns up having done the reading.

Meet regularly. A fixed weekly time beats ad hoc sessions arranged the night before an exam.

Agree on a goal for each session. "Go through Week 5's problem set" or "quiz each other on the three essay topics". Without a goal, a session drifts.

Prepare before you meet

The group is for working *with* material, not reading it for the first time. Before each session:

- Everyone covers the agreed material on their own.
- Everyone brings two or three questions about what they didn't understand.
- Optionally, each person prepares a few quiz questions for the others.

What to do in the session

Quiz each other. Take turns asking questions, and answer from memory, not from notes. Wrong answers are the useful part, because they show the group what to revisit. The active recall guide explains why this works.

Teach in turns. Split the topics, and have each person explain one to the group without notes. Then the others ask questions until the gaps show. It's the Feynman Technique with a live audience.

Work through your questions. Go round the questions people brought. If nobody can answer one, note it for the lecturer.

Do practice papers together, then compare and argue about the answers. Explaining *why* you chose an answer is where the learning happens.

Finish with a summary. In the last five minutes, each person says one thing they'll review before next time.

Keep it on track

- **Use a timer.** Work in focused blocks with real breaks. The chat goes in the breaks.
- **Phones away during blocks.**
- **Rotate a leader** who keeps the session to its goal.
- **Don't let one person do all the work.** If someone always explains, ask them to ask the questions instead.

Sharing material

A group quickly ends up with notes, slides and summaries scattered across chats and drives. Pick **one shared place** for the group's material, with the same folder layout for everyone. The guide on organizing study notes has a structure that works. It saves the "who has the Week 3 slides?" message every week.

Common mistakes

- **No preparation.** Then the session becomes a slow lecture.
- **Studying side by side in silence.** That's just studying alone in company. Use the group for what only a group can do.
- **Too big a group.**
- **Copying someone else's answers.** Shared understanding is the goal, not shared homework.

Doing this in Atheneum

In Atheneum, a notebook can be shared. The owner invites people by username from the notebook's People panel, as a **viewer** (who can study everything in it) or a **contributor** (who can also add files, folders, summaries, quizzes and flashcard decks). Invites show up on the other person's Notebooks page, where they accept or decline.

Everyone sees the same material, with labels showing who added what. Each person keeps their own quiz scores and flashcard progress, so you can revise from the same notebook at your own pace. A contributor uses their own AI credits and storage for what they add. How many notebooks you can share, and with how many people, depends on the owner's plan.

Between sessions, quizzes and flashcards in Review give everyone the same practice to bring back to the group.

A quick start

1. Find two to four classmates who'll do the reading.
2. Agree on a weekly time and one goal for the first session.
3. Everyone prepares the material and brings three questions.
4. In the session: quiz each other for 25 minutes, break, then teach one topic each.

The best study groups are a bit uncomfortable: lots of questions, lots of wrong answers said out loud. That's what makes them worth showing up for.

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Online: atheneum.app/guides/how-to-study-in-a-group · Updated 2026-10-23

GUIDE 14 · MEMORY · 7 MIN READ

Sleep and Studying: Why Sleep Helps You Remember

What research says about sleep and memory, why all-nighters backfire, and how to plan revision so sleep does part of the work for you.

THE SHORT ANSWER

Sleep is part of how learning sticks. During sleep, recently learned material is reactivated and stabilized, and one night without sleep can make the next day's learning weaker. Losing a night hurts attention most. Plan revision so you study, sleep, then review, and keep a steady sleep schedule through the term, not just the night before.

When time is short before an exam, sleep is usually the first thing to go. It feels like a fair trade: two more hours of revision for two fewer hours in bed. The research suggests it is usually a bad one. Sleep is not time off from learning. It is part of how learning sticks. This guide covers what the evidence says, what an all-nighter actually costs, and how to plan your revision around sleep instead of against it.

What sleep does for memory

Learning something new doesn't finish when you close the book. For hours afterwards, the brain keeps working on new memories, a process called *consolidation*. A large review by Diekelmann and Born (2010) describes sleep as a state that favors this process: during sleep, recently learned material is reactivated and gradually stabilized, so it is more likely to be there later.

Sleep matters on both sides of studying:

- **Sleep after learning** helps you keep what you learned that day.
- **Sleep before learning** helps you take in new material the next day. In a brain-imaging study, Yoo and colleagues (2007) found that after one night without sleep, people showed weaker activity in the hippocampus (a region central to forming new memories) while learning, and remembered less of what they studied.

So a short night doesn't just make you tired. It can make tomorrow's studying less effective, too.

What an all-nighter costs

Pulling an all-nighter is common. In one survey of 120 students at a US college, 60% said they had stayed up all night at least once since starting college (Thacher, 2008). Those who did tended to have lower grades. That study is correlational, so it can't show that all-nighters *cause* lower grades (students who are already struggling may be more likely to pull them), but it is not a good sign.

Other studies point the same way:

- **Attention takes the biggest hit.** A meta-analysis of 70 studies on short-term total sleep deprivation found effects across attention, working memory and processing speed. The largest was on simple attention, such as lapses where you just miss things (Lim & Dinges, 2010). On an exam, that looks like misreading a question or skipping a step you know.
- **Trading sleep for study can backfire the next day.** A daily-diary study followed 535 high school students over two weeks in three different school years. On days when students gave up sleep to study more than usual, they reported more trouble understanding what was taught in class and were more likely to struggle on a test or assignment the next day (Gillen-O'Neel et al., 2013). This held regardless of how much each student usually studied.

One more finding is worth knowing. In a study that gave 88 college chemistry students sleep trackers for a semester, longer, better and more regular sleep went with higher grades. But sleep on the single night before a test was *not* related to that test's score; sleep over the week and month beforehand was (Okano et al., 2019). Again, this is a correlation in one class, so read it with care. The practical message is that sleep isn't something you can bank the night before. It's a habit across the whole term.

Sleep between study sessions

One encouraging study suggests sleep can actually save you study time. Mazza and colleagues (2016) had 40 people learn foreign-language vocabulary in two sessions 12 hours apart. One group studied in the morning and relearned in the evening of the same day. The other studied in the evening, slept, and relearned the next morning. The group that slept in between needed about half as much practice to relearn the words, and remembered them better a week later and six months later.

It is one small study, but it fits what we know about consolidation and about spaced repetition: spreading study across days, with sleep in between, tends to beat cramming it into one long day. If you are learning a language, the vocabulary guide builds on this.

How to plan revision around sleep

Study a topic, then sleep, then review it. An evening session followed by a short review the next morning is a good pattern for anything you need to memorize.

Protect sleep in the final week. This is when it feels most tempting to cut it, and when cutting it costs the most. If you are behind, drop low-value tasks (recopying notes, rereading) before you drop sleep.

Keep a steady schedule. Going to bed and waking up at roughly the same times is easier on your body than catching up on weekends.

Start earlier, not later. The best fix for an all-nighter is a plan that doesn't need one. An exam revision timetable that starts a few weeks out leaves room for sleep.

If you do lose a night, keep the next day simple. Use it for review and practice questions you can check, not for learning hard new material. Then get back to a normal night as soon as you can.

Wind down before bed. Finish studying a little before you go to sleep, and if worries about the exam are keeping you up, the guide on exam anxiety has some ideas worth trying.

This guide is about studying, not sleep problems. If you regularly struggle to fall or stay asleep, talk to a doctor or your school's health service.

Common mistakes

- **Treating sleep as optional study time.** It is part of the learning, not time away from it.
- **Banking on one good night before the exam.** The evidence points to sleep over the whole term mattering more.
- **Cramming new material late at night.** Tired attention takes in less. Do new material earlier and use late sessions, if you must, for light review.
- **Catching up only on weekends.** An irregular schedule makes the weekdays harder.

Doing this in Atheneum

Atheneum doesn't track your sleep. What it can help with is the planning that makes late nights unnecessary.

- **Calendar and tasks.** Put your exam dates in the calendar and plan revision sessions earlier in the day, with an end time you stick to. The task board is a good place to put tomorrow morning's short review the night before.
- **Flashcards.** Review's Flashcards tab schedules each card for you, so a short daily review replaces a long cram. Study an evening session, then clear the cards that are due the next morning.
- **The daily review goal.** Review has a daily goal (10, 20, 30 or 50 questions, cards or blurting points) and a streak. A small daily goal is the opposite of an all-nighter: steady, short and done before bed.
- **The Pomodoro timer.** The focus timer makes it easy to stop at a set time. Decide how many rounds you'll do tonight, and stop when they are done.

A quick start

1. Pick a bedtime for exam season that leaves you seven or more hours, and put it in your calendar as a reminder.
2. Plan tonight's study to end 30 to 60 minutes before it.
3. Study one topic this evening, then review it with flashcards or a quick blurt tomorrow morning.
4. If you're tempted to stay up, cut a low-value task instead of an hour of sleep.

Sleep is one of the few study techniques that happens while you rest. Let it do its share.

Read next: should you pull an all-nighter?, on what a night without sleep costs and what to do the night before instead.

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Online: atheneum.app/guides/sleep-and-studying · Updated 2026-10-23

GUIDE 15 · UNDERSTANDING · 6 MIN READ

Ask "Why?": Elaborative Interrogation and Self-Explanation

How asking yourself why a fact is true, and explaining each step as you study, builds understanding, plus what the evidence does and doesn't show.

THE SHORT ANSWER

Elaborative interrogation means asking yourself why a fact is true; self-explanation means explaining how each new idea or solution step fits with what you already know. A major review rated both moderate utility, below practice testing and spaced practice. They work best on material with reasons behind it, and your explanations should be checked against the source.

Some facts slip away almost as soon as you read them. Others stick because you can see *why* they are true. Two closely related techniques build on that difference. **Elaborative interrogation** means asking yourself "why is this true?" as you study. **Self-explanation** means explaining to yourself how each new piece of information fits with what you already know, or why each step of a solution works. Both turn reading into thinking, and both are easy to start today.

What the two techniques are

Elaborative interrogation is a fancy name for a simple habit. When you meet a fact, you stop and ask *why*:

- "Why does increasing the temperature speed up this reaction?"
- "Why did this policy make inflation worse?"
- "Why would this muscle need so many mitochondria?"

Then you try to answer it, using what you already know.

Self-explanation is broader. As you read a text or study a worked solution, you explain it to yourself, step by step: what this sentence means, how it connects to the last one, why this step follows from the one before. You can do it in your head, out loud or on paper.

The two overlap. Both make you connect new material to what you already know, rather than letting it sit on the page as an isolated line.

What the research says

In their review of ten study techniques, Dunlosky and colleagues (2013) rated both elaborative interrogation and self-explanation as **moderate utility**. That is below practice testing and spaced practice, which they rated high, and above rereading and highlighting, which they rated low. They were

clear about why it isn't higher: the benefits seemed real, but at the time neither technique had been adequately tested in real classrooms, so how well they work in practice was still uncertain.

Some of the key evidence:

- **Self-explanation and worked examples.** Chi and colleagues (1989) listened to students think aloud while studying physics examples. The students who learned most generated many explanations, connecting each step to the principles in the text, and noticed when they didn't understand something. Weaker students explained less and later leaned heavily on copying the examples.
- **Prompting helps.** In a follow-up, Chi and colleagues (1994) asked eighth-graders to explain each line of a text on the circulatory system to themselves. They gained more from it than a group that read the text twice. It was a small study, with 14 students prompted and 10 in the comparison group, so it is a starting point rather than proof.
- **Across many studies.** A meta-analysis of 64 research reports (69 effect sizes) found that prompting learners to self-explain while studying or solving problems produced a moderate overall benefit, and the authors found it promising across a range of conditions, including different tasks, subjects and levels of education (Bisra et al., 2018).

The mixed part is worth knowing too. A later meta-analysis on worked examples in math found the opposite of what you might expect: in the studies it reviewed, worked examples paired with self-explanation prompts did *worse* than worked examples without them (Barbieri et al., 2023). Self-explanation is a strong habit, but not one that improves every activity it is added to.

Why it works

- **It links new facts to old ones.** A fact attached to something you already understand has more routes back into memory.
- **It shows you what you don't understand.** If you can't answer "why?", you have found a gap. Reading again would have let you skip past it.
- **It builds the reasoning, not just the answer.** Exams often ask you to apply an idea to a new case, which needs the *why*, not just the *what*.

How to do it

Ask "why?" at the end of each paragraph or slide. Pick the main claim and ask why it is true. Answer in a sentence or two, without looking back if you can.

Explain each step of a worked solution. For every line, say what was done and why: "They divided both sides by 3 to get x alone." If you can't say why a step was taken, that step is what to study.

Use what you know. The best answers connect to something you already understand: another topic, an everyday experience, an earlier lecture. A concrete example is often the quickest bridge.

Check your answer. A confident but wrong explanation is worse than none, because it feels like understanding. Check your answer against your notes or textbook, especially early in a topic.

Write some of it down. Explaining in your head is quick, but writing makes it harder to skip a step you can't actually explain.

Where it works best, and where it doesn't

- **It needs some background knowledge.** Answering "why?" draws on what you already know. On a brand-new topic you may just guess, so learn the basics first.
- **It suits facts with reasons behind them.** Science, history, economics and law are full of *why*. It works less well for arbitrary facts, such as vocabulary or dates, where there is nothing to explain. For those, retrieval practice and spacing do more. See the vocabulary guide.
- **It takes time.** Asking "why?" about every sentence is slow. Save it for the key ideas.
- **It is not a test.** Explaining with the book open helps you understand, but it doesn't tell you what you can recall later. Pair it with active recall.

Common mistakes

- **Accepting "because it is" as an answer.** If the answer doesn't add a reason, keep going or look it up.
- **Paraphrasing instead of explaining.** Restating a step in other words is not the same as saying why it works.
- **Never checking.** Make sure your explanations match the material, or you'll learn your own mistakes.

Doing this in Atheneum

You can ask yourself "why?" with nothing but a notebook. Atheneum gives you a few places to make it a habit.

- **Notes in your notebook.** Open a notebook's Notes tab and write your "why?" questions and answers in Markdown, next to the lecture they belong to. The notebook keeps the source files in the same place, so checking an answer is one click away.
- **Athena as the questioner.** Ask Athena, the AI tutor, to ask you "why?" questions about a file in your notebook, one at a time, and to wait for your answer before responding. She can then point out what your explanation missed. She can be wrong, so check her feedback against your material; the guide on studying with an AI tutor covers how.
- **Quizzes with feedback.** A quiz in Review gives a short note on anything you missed. Turn each missed question into a "why?" question and answer it in your own words.

A quick start

1. Pick one section of a lecture you've already read.

2. For each paragraph, write one "why?" question about its main point.
3. Answer each one in a sentence, using what you already know, then check it against the source.
4. Mark the questions you couldn't answer, and study those first next time.

Asking "why?" turns a fact you've seen into a fact you understand. It's a small habit with a large payoff.

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GUIDE 16 · UNDERSTANDING · 6 MIN READ

Dual Coding: Combining Words and Pictures When You Study

What dual coding is, what research on words and visuals together shows, why it isn't about being a "visual learner", and simple ways to use it.

THE SHORT ANSWER

Dual coding means studying with words and visuals together, such as a labeled diagram, timeline or flowchart beside your notes. Experiments suggest words and pictures presented together, with visuals that show how something works, can improve understanding. It is not about being a visual learner; learning styles lack evidence, and everyone can benefit when the visual shows structure.

Think of how a bicycle pump works. You probably didn't recall a paragraph. You pictured the handle going down and the air going out. Some ideas are much easier to hold as a picture than as a sentence, and many are easiest as both. **Dual coding** means studying with words and visuals together: a diagram with labels, a timeline next to your notes, a sketch of a process alongside a written explanation. This guide covers what the research shows, what it doesn't, and how to use it without turning revision into an art project.

What dual coding is

The name comes from *dual coding theory*, developed by the psychologist Allan Paivio. It proposes that we have two connected systems for representing information: one for words and one for nonverbal images (Paivio, 1991). Information held in both forms, with links between them, has more ways to be understood and remembered.

In practice, dual coding means pairing words with a visual that shows the same idea:

- a labeled diagram of the heart beside your notes on circulation;
- a timeline of the causes of a war;
- a graph sketched next to an economics definition;
- a flowchart of the steps in an algorithm.

The visual is not decoration. It should show something about the idea, such as its parts, its steps or how its pieces relate.

What the research says

Some of the clearest evidence comes from Richard Mayer's experiments on learning how things work.

- **Words and pictures together, at the same time.** Mayer and Anderson (1991) showed college students an animation of a bicycle pump. Students who heard the explanation *while* watching did better on problem-solving questions about how the pump works than students who heard it *before* the animation, or who got only the words, or only the animation.
- **The right picture matters.** Mayer and Gallini (1990) gave students short texts explaining how scientific devices work. Only illustrations showing both the parts and the steps of the process helped, and they mainly helped students who knew little about the topic. Illustrations that just labeled parts, or just labeled steps, didn't consistently help.
- **Drawing helps you remember.** In seven experiments, Wammes and colleagues (2016) found that people remembered words better when they drew them than when they wrote them out. These were simple word lists in a lab, so the finding is solid but narrow. It doesn't show that drawing beats every other way of studying a textbook.

The mixed part is worth knowing too. Dunlosky and colleagues (2013) reviewed a related technique, forming mental images while reading a text, and rated it low utility: it helped some students on some tasks, but the benefits were limited and inconsistent. Dual coding works best with real visuals that show structure, not with vague mental pictures.

A review written for teachers by Weinstein, Madan and Sumeracki (2018) lists dual coding among six learning strategies with research support, alongside spaced practice, retrieval practice, interleaving, elaboration and concrete examples.

It isn't about being a "visual learner"

Dual coding is often confused with *learning styles*: the idea that some people are "visual learners" and others "verbal learners", and each learns best when taught in their style. A review by Pashler and colleagues (2008) looked for the kind of experiment that would support that idea and found virtually no evidence for it, while several well-designed studies contradicted it.

Dual coding is different. It suggests that *everyone* can benefit from words and visuals together, when the visual shows something meaningful. Choose the format that suits the material (a process needs a flowchart, a sequence needs a timeline) rather than one that suits a label you've given yourself.

How to use dual coding

Pick visuals that match the idea. Processes become flowcharts. Sequences become timelines. Comparisons become tables. Parts of a whole become labeled diagrams. Relationships become a concept map.

Keep words and visuals together. Put labels on the diagram, not in a separate list. Write the explanation beside the picture, not three pages later.

Draw it yourself. Copying a diagram from the slides is a start. Redrawing it from memory, then checking it against the original, is better, because now you're practicing active recall as well.

Keep it simple. Boxes, arrows and stick figures are enough. Time spent on shading and color is time not spent learning.

Explain your visual out loud. Talk through what each part shows and why the arrows point where they do. If you can't, the drawing is hiding a gap.

Use it for the right things. Dual coding suits anything with structure: processes, systems, cycles, timelines and spatial ideas. For an isolated fact, such as a definition or a word in another language, a flashcard is usually quicker.

Common mistakes

- **Decorating instead of explaining.** A pretty page isn't the same as a useful diagram.
- **Separating words and pictures.** The benefit comes from linking them.
- **Only ever copying.** Redraw from memory, then check.
- **Sticking to one format because you're "a visual person".** Choose the format that fits the material.

Doing this in Atheneum

Atheneum doesn't have a drawing or diagram tool, so the visual part happens on paper or in whatever drawing app you already use. Atheneum helps with the words, the checking and the practice.

- **Write the words, draw on paper.** Keep your written explanation in a notebook's Notes tab, in Markdown, and sketch the diagram on paper beside it. Markdown tables are handy for comparisons.
- **Use the source to check your drawing.** Your lecture slides stay in the notebook's files, so after redrawing a diagram from memory you can open the original and compare.
- **Ask Athena to quiz you on the structure.** Ask Athena to ask you questions about how the parts of a process connect, then answer by sketching. She works from the text of your files, and she can be wrong, so check against the material.
- **Blurt with a diagram.** Blurt Mode in Review gives you a blank space with your notes hidden. For a process or a system, sketch it on paper from memory first, then write out what the sketch shows in the blurt box and select **Check with Athena** to see which key points of the file you left out. The blurting guide explains the method.

Summaries, quizzes and flashcards are built from the text in your files and notes, so a drawing on its own won't feed them.

A quick start

1. Pick one topic with a clear structure: a process, a cycle or a sequence.
2. Draw it as a simple labeled diagram, with a one-line explanation next to each part.
3. Tomorrow, redraw it from memory, then check it against your notes and fix what's missing.

4. Explain the diagram out loud in under two minutes.

Words and pictures together give you two ways in. That's the whole idea.

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GUIDE 17 · UNDERSTANDING · 6 MIN READ

Concrete Examples: Making Abstract Ideas Click

Why studying concrete examples helps you understand abstract concepts, how to choose and use them well, and where examples can mislead you.

THE SHORT ANSWER

Studying several concrete examples of an abstract concept helps you recognize it in new situations; in experiments, it beat spending extra time on the definitions. Use two or three examples that differ on the surface, link each back to the definition, and check any examples you invent, since students judge their own poorly.

Definitions are compact, and that's the problem. "Negative reinforcement: increasing a behavior by removing an unpleasant stimulus" is accurate, but it's hard to *see*. Then someone says: "You buckle your seatbelt so the car stops beeping." Suddenly it makes sense. **Concrete examples** turn abstract ideas into something you can picture, and they are one of the simplest tools you have for understanding a concept, not just memorizing its definition.

Why examples help

Most courses are full of *declarative concepts*: key terms with short definitions that apply to many situations. Opportunity cost, confirmation bias, natural selection, a metaphor, a tort. Exams rarely ask you to repeat the definition word for word. They describe a situation and ask which concept it shows, or ask you to apply the concept to a new case.

That is what examples train. Each one shows the definition at work in a specific situation. Seeing several, each different on the surface, helps you pick out what they all have in common: the part that actually makes something an instance of the concept.

What the research says

- **Examples beat rereading the definition.** In three experiments, Rawson, Thomas and Jacoby (2015) had students learn definitions of concepts, then either study illustrative examples or spend extra time studying the definitions. On a later test that described new scenarios and asked which concept each one showed, students who had studied examples did clearly better. How the examples were presented mattered, though: it made a difference how examples of different concepts were mixed together, and whether the definition was shown with them.
- **Provided examples can beat making up your own.** You might expect inventing your own examples to work better, since it takes more effort. In two experiments with college students learning concepts from social psychology, Zamary and Rawson (2018) found that studying

provided examples led to better learning two days later, and took less time, than generating examples or a mix of both.
- **Students struggle to judge their own examples.** A related study's title sums it up: students were not good at judging whether the examples they made up were correct, and feedback didn't fix that (Zamary, Rawson, & Dunlosky, 2016). An example you invent can be wrong without you noticing.

A review written for teachers by Weinstein, Madan and Sumeracki (2018) lists concrete examples among six learning strategies with research support, along with spaced practice, retrieval practice, interleaving, elaboration and dual coding.

Where examples can mislead

Examples are not always the best route. In a short report, Kaminski, Sloutsky and Heckler (2008) found evidence that undergraduates may learn a mathematical concept better from a single abstract, symbolic version than from several concrete examples. Concrete details can be memorable for the wrong reasons: you remember the story, not the structure underneath it.

Two practical lessons follow:

- **One example isn't enough.** If every example of "opportunity cost" you've seen involves money, you might think the concept is about money. Use several examples that differ on the surface.
- **Always connect the example back to the principle.** After each one, say which part of the example matches which part of the definition. That link is what lets you recognize the concept in a situation you haven't seen.

How to use concrete examples

Collect two or three examples for each key concept. Start with the ones in your lectures and textbook. Make sure they differ: one from everyday life, one from the course, one from the news.

Label each part. For each example, write how it matches the definition: "The beeping is the unpleasant stimulus. Buckling up removes it. The behavior, buckling up, increases."

Add a non-example. Something that looks similar but isn't the concept. "Being given a sticker for buckling up is *positive* reinforcement, not negative." Non-examples sharpen the edges of a concept.

Mix concepts when you practice. Once you know a few related concepts, take examples of all of them, shuffle them, and practice saying which concept each one shows. That is how exams test you, and it builds on interleaving.

If you make up your own, check them. Generating examples can be useful for testing your understanding, but check each one against your notes, ask a teacher, or compare it with examples from the textbook.

Explain why it's an example. Asking "why does this count?" is elaborative interrogation, and it is what turns an example into understanding. A quick sketch of the situation adds a second route in, as the dual coding guide explains.

For problem-solving subjects such as math and physics, the related technique is studying fully worked examples before solving problems on your own.

Common mistakes

- **Learning only the definition.** It feels efficient, but it won't help you spot the concept in a new situation.
- **Relying on one memorable example.** You'll mistake its surface details for the concept.
- **Trusting examples you made up without checking them.** They can be wrong without you noticing.
- **Remembering the story but not the principle.** Always link the example back to the definition.

Doing this in Atheneum

- **Keep your examples next to the concept.** In a notebook's Notes tab, write each concept with its examples and a non-example, in Markdown. A table works well, with columns for concept, example, why it fits and non-example.
- **Ask Athena for more examples, then check them.** Athena works from the files in your notebook. Ask her for two more examples of a concept that differ from the ones in your lecture, and to explain how each one matches the definition. She can be wrong, so check her examples against your material just as you would your own.
- **Practice classifying.** Quizzes in Review can be generated across a whole notebook, so questions on related concepts come mixed together. The result after each quiz lists what you missed and points you to the summaries, study guides or cards that cover it.
- **Make cards that ask for the concept.** If you write your own flashcards, put a scenario on the front and the concept on the back, rather than the other way round. You can import your own cards as a text file; the flashcards guide shows how.

A quick start

1. Choose three related concepts from one lecture.
2. For each, find two examples that differ on the surface, and one non-example.
3. For every example, write one sentence linking it to the definition.
4. Shuffle all the examples and practice naming the concept each one shows.

A good example makes an abstract idea concrete. A few good examples, tied back to the principle, make it yours.

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GUIDE 18 · UNDERSTANDING · 6 MIN READ

Worked Examples: Learn Problem Solving, Then Fade the Help

Why studying worked examples helps beginners learn math and science problem solving, how to fade them into solo practice, and when to stop using them.

THE SHORT ANSWER

Research suggests beginners learn math and science problem solving better by studying fully worked examples before solving problems alone. Study two or three examples of each problem type, then fade the help: complete examples with steps missing until you can solve problems from scratch. Once you can solve a type reliably, stop studying examples and practice.

When you're new to a type of problem, the usual advice is "just do lots of practice problems." But if you don't yet know how to solve them, practice can turn into guessing, getting stuck and copying the answer from the back of the book. There's a better first step. A **worked example** is a problem with every step of the solution shown. Studying a few carefully, then gradually doing more of the work yourself, is one of the best-researched ways to learn problem solving in math and science.

What a worked example is

A worked example shows a problem, the steps to solve it, and the final answer. Textbooks and lecture slides are full of them. The difference is in how you use them:

- **Skimming** an example on the way to the exercises gives you little.
- **Studying** it means following each step, knowing why it was taken, and being able to reproduce the method afterwards.

The idea is simple: when you're a beginner, solving a problem from scratch uses up so much effort on searching for a method that there's little left over for learning the method itself. A worked example shows you the method directly, so your effort goes into understanding it.

What the research says

- **The original studies.** In a series of experiments on algebra, Sweller and Cooper (1985) found that students who studied worked examples took much less time to get through them than students who solved the same problems conventionally, and then solved similar problems faster and with fewer errors. The benefit was specific, though: it showed up on problems with the same structure as the examples, not on different kinds of problem.
- **Across many studies.** A meta-analysis of 55 studies on math found a medium-sized benefit of worked examples overall, whether they were used when first learning a skill or for later practice. Examples showing correct solutions helped more than examples showing mistakes, alone or mixed

with correct ones (Barbieri et al., 2023).

- **Good examples share some features.** A review of the worked-examples research by Atkinson and colleagues (2000) recommends several examples for each type of problem, with varied formats, and placing practice problems right next to the examples they match.

Fading: from examples to solving on your own

Studying examples forever won't make you a problem solver. At some point you have to solve problems alone, as you will in the exam. The research suggests getting there gradually.

Renkl and colleagues (2002) tested a **fading** approach. Learners started with a complete worked example. The next example had one step missing for them to fill in, the one after that had two, and so on until they were solving whole problems on their own. Across a classroom study and two lab experiments, fading helped learning, at least on problems similar to the ones practiced. Removing steps from the *end* of the solution first (backward fading) worked better than removing them from the start.

A simple fading sequence looks like this:

1. **Study** a fully worked example.
2. **Complete** a similar example with the last step missing.
3. **Complete** another with the last two steps missing.
4. **Solve** a similar problem from scratch.
5. **Check** your solution against a worked answer.

When to stop using worked examples

Worked examples help most when you're a beginner. Kalyuga and colleagues (2003) reviewed studies showing that techniques that help inexperienced learners can lose their benefit, and even get in the way, once learners are more experienced. They called this the *expertise reversal effect*.

So the rule is: examples first, then fade, then practice. Once you can reliably solve a type of problem, studying more examples of it is mostly wasted time. Move on to solving problems, and mix different problem types together; the interleaving guide explains why.

How to study a worked example

Cover the solution and predict each step. Before you read the next line, try to say what it will be. Then check. This makes you think rather than just follow along.

Say why each step was taken. "They used the chain rule here because the function is nested." Explaining steps to yourself is a useful habit, as the guide on asking "why?" explains, and students who learn most from examples tend to do it (Chi et al., 1989). The evidence on *adding prompts* to worked examples is mixed, though: the meta-analysis above found that, in the studies it reviewed, examples with self-explanation prompts did worse than examples without them. Keep your explanations short and focused on the steps you don't yet understand.

Study two or three examples of each problem type. One example shows you one problem. Several, with different numbers and wording, show you the method.

Pair each example with a similar problem. Study an example, then immediately solve a matching problem. Then fade.

Watch for the type, not just the steps. Notice what about the problem tells you which method to use. That's what you'll need when the problem isn't labeled.

Common mistakes

- **Skimming examples.** Following along feels like understanding. Covering and predicting shows whether it is.
- **Jumping to hard problems too early.** Struggling for an hour without a method teaches you little.
- **Never fading.** Studying examples alone won't prepare you for an exam with no examples.
- **Staying with examples too long.** Once you can solve a problem type, practice it, don't study it.

Doing this in Atheneum

- **Keep examples and practice together.** Upload your lecture slides, problem sheets and solutions to a notebook for the subject, so examples and matching problems are in one place. Write your own faded versions in the notebook's Notes tab, in Markdown.
- **Ask Athena for a matching problem.** After you've studied an example from your notes, ask Athena for a similar problem with different numbers, and to hold back the solution until you've tried. You can also ask her to show only the first steps, so you finish the rest. Check her working: AI tutors can make mistakes in calculations, and the guide on studying with an AI tutor explains how to stay safe.
- **Test yourself once you're ready.** Quizzes in Review check whether you can choose the right method without the example in front of you. Start at beginner difficulty and move up to intermediate and advanced as your scores rise; every quiz can be retaken.
- **Use a study guide for extra practice.** A notebook's study guide includes examples, common mistakes and practice questions built from your material.

A quick start

1. Pick one type of problem you find hard.
2. Study two worked examples, covering each step and predicting it before you read it.
3. Complete a similar problem with the last step left for you, then one with the last two steps.
4. Solve one from scratch, check it, and if you got it right, move on to mixed practice.

Watch, then help, then do it alone. That's how most skills are learned, and problem solving is no different.

Read next: how to study for a math exam, on putting examples, mixed practice and timed papers together.

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GUIDE 19 · MEMORY · 7 MIN READ

How to Learn Vocabulary in a New Language (and Keep It)

An evidence-based way to learn foreign-language vocabulary: recall instead of rereading, spaced review, both directions, and words in context.

THE SHORT ANSWER

Test yourself instead of rereading: cover the translation and try to produce the word before checking. Review words on a spaced schedule, practice both directions, especially from your own language to the new one, and meet words in real sentences. Learn small batches daily rather than cramming, and treat memory tricks as occasional help, not a method.

Learning a language means learning thousands of words, and most students do it the same way: read down a list, cover the translations, read it again. It works for tomorrow's quiz and fades by next month. A few changes, all well supported by research, make words stick for much longer. Test yourself instead of rereading, spread reviews out over time, practice in both directions, and meet words in real sentences. This guide shows how.

Test yourself, don't just reread

The single biggest change is to *recall* words instead of looking at them.

In a well-known experiment, Karpicke and Roediger (2008) had university students learn foreign-language vocabulary through repeated rounds of study and testing. Once a student got a word right, the researchers changed what happened to it next: some words kept being studied but were no longer tested, others kept being tested but were no longer studied. On a delayed test, extra studying had made no difference. Extra testing produced a large improvement. Students' predictions of how well they'd do didn't match how well they actually did, which suggests most of us don't realize how much testing helps.

The same goes for speaking. Kang, Gollan and Pashler (2013) taught learners new spoken words with pictures. Learners who tried to say each word *before* hearing it understood and produced the words better than learners who simply heard each word and repeated it, with no loss in pronunciation.

So when you study a word, cover the answer and try to produce it first. Then check. The active recall guide explains why this works for any subject.

Spread your reviews out

Words fade quickly at first and more slowly each time you review them. That makes the timing of reviews important.

A review of the research by Kang (2016) concluded that spacing out repeated practice over time leads to better long-term learning than doing the same practice in one go, and that testing during those spaced reviews increases the benefit further.

One unusual study shows what this looks like over years. In a nine-year study, four people learned 300 foreign-language word pairs and relearned them in sessions spaced 14, 28 or 56 days apart, then were tested up to five years later. Longer gaps slowed learning slightly but led to substantially better long-term retention. Thirteen sessions spaced 56 days apart kept words about as well as 26 sessions spaced 14 days apart (Bahrick et al., 1993). With four participants, it isn't a definitive result, but it fits what larger studies have found.

The easy way to space reviews is to let a flashcard system schedule them for you. The spaced repetition guide explains how that works. Sleep helps too: in one study of vocabulary learning, people who slept between two study sessions needed about half as much practice to relearn the words (Mazza et al., 2016). The guide on sleep and studying covers that study.

Practice in both directions

Recognizing a word ("*chien* means dog") is easier than producing it ("dog is... *chien*"). They are different skills, and you need both.

Webb (2009) taught English learners in Japan new words either receptively (learning to give the meaning of a new word) or productively (learning to give the new word for a meaning). Each direction built different kinds of knowledge. Productive learning led to larger gains on more of the measures, including spelling and how the word is used grammatically, while receptive learning led to larger gains in recognizing a word's meaning. The author's conclusion: if you can only practice one way, practicing production may be the better choice.

In practice: make cards in both directions, and pay most attention to the direction you find harder, which is usually from your own language to the new one.

Meet words in context

Word lists teach you a word's meaning. Real language teaches you how it's used. Both matter.

Webb (2008) had English learners meet new words in short passages, some with plenty of clues to the meaning and some with few. Learners who read the more helpful passages learned more about the words' meanings. The study suggests the *quality* of the context matters more for learning meaning, while the number of encounters matters more for learning the word's form.

So once you've learned a word on a card, look for it in sentences: in your textbook, in reading you enjoy, in songs or shows. When you add a card, include a short example sentence on the back, ideally one from a real text.

What about memory tricks?

The *keyword method* links a new word to a similar-sounding word in your language with a vivid image, like picturing a *cat* sitting on a *gato* (Spanish for cat). It can help in the short term, but Dunlosky and colleagues (2013) rated it low utility in their review: it is hard to use in some contexts, helps with a limited range of material, and its benefits showed up mainly over short periods. It's fine for the odd word that won't stick, but it's not a substitute for spaced recall.

How to learn vocabulary, step by step

1. **Take words in small batches.** Ten to twenty new words a day is plenty for most learners, and easier to keep up than a hundred once a week.
2. **Make a card for each word, in both directions.** Front: the word in the new language. Back: the meaning, plus a short example sentence. Then the reverse.
3. **Always try to answer first.** Say or write the answer before you flip, out loud if you're learning to speak.
4. **Review on a schedule.** Do your due cards every day. Missed words come back sooner, known words later.
5. **Use the words.** Read, listen and write a few sentences of your own with the week's new words.

Common mistakes

- **Rereading lists.** It feels productive and does very little. Cover and recall.
- **Only practicing one direction.** You'll recognize words you can't produce.
- **Cramming before a test.** Words learned in one long session fade fast. Little and often wins.
- **Too many new words at once.** Reviews pile up, and you'll stop. Pick a pace you can keep for months.

Doing this in Atheneum

Atheneum has no language-specific tools, but its flashcards do the scheduling for you.

- **Import your own word list.** Write your words in a plain text file, one per line: the word, a tab, then the meaning (a comma also works). Add a second line with the two reversed to practice the other direction. Then import the file into a deck from the Flashcards tab in Review. A single import can hold up to 500 cards. If you already use Anki, you can import an Anki export the same way, and export any deck back to Anki at any time.
- **Study with spaced repetition.** Flip each card and rate it Again, Hard, Good or Easy. Each card gets its own due date, so the words you miss come back sooner. On a keyboard, Space flips the card and 1 to 4 rate it.
- **Set a daily goal.** Review has a daily goal and a streak, counting cards rated, questions answered and blurting points marked. A small, steady goal suits vocabulary well.

- **Generate cards from your course.** If your course has reading lists or handouts, upload them to a notebook and generate a deck from them. Check the generated cards against your material before studying them; the flashcards guide explains what to look for.

A quick start

1. Choose 15 words from this week's lessons.
2. Make cards in both directions, each with a short example sentence.
3. Study them today, answering before you flip, and review whatever is due each day after.
4. At the end of the week, write five sentences using the new words.

Recall, space and use. That's how a word goes from familiar to yours.

Read next: the memory palace, a memory technique that can help with lists and sequences, and how to make good flashcards.

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GUIDE 20 · EXAMS · 7 MIN READ

Exam Anxiety: What Helps Before a Test (and What's Unproven)

What research says about exam nerves: why preparation helps most, what's known about writing out worries and reframing nerves, and when to get support.

THE SHORT ANSWER

The most reliable protection is preparation you trust: revise with practice questions, start early, protect your sleep and do a timed practice paper. Reframing nerves as excitement has promising but limited evidence, and writing out worries before a test looked helpful at first but later studies found little reliable benefit. Severe anxiety deserves real support.

A racing heart, a blank mind, the feeling that everything you revised has gone. Most students feel some nerves before an exam, and for some those nerves get in the way. This guide covers what research says about exam anxiety, a few simple techniques that have been tested, and, just as important, where the evidence is weaker than it's often made to sound. It isn't medical advice. If anxiety is affecting your sleep, health or daily life, talk to a doctor or your school's counseling service.

How much does anxiety matter?

A meta-analysis of 238 studies over 30 years found that test anxiety is consistently linked to lower performance, on standardized tests, university entrance exams and grades. The relationship was in the small-to-moderate range (von der Embse et al., 2018). So anxiety matters, but it isn't destiny: plenty of nervous students do well, and some nerves are normal.

That review also found that test anxiety was higher when a test was seen as difficult or high-stakes. You can't change the stakes, but you can change how prepared you feel, which brings us to the most reliable advice.

The best protection is preparation you trust

Feeling unprepared is a reason to be anxious. The most reliable fix isn't a trick on the morning of the exam. It's revising in a way that makes you confident you can actually recall the material.

There's some evidence that *how* you revise matters here. In a lab study, Smith, Floerke and Thomas (2016) had people learn material either by restudying it or by practicing retrieval (taking practice tests). A day later, half of the participants were put under acute stress before being tested. People who had restudied showed the usual stress-related drop in memory. People who had practiced retrieval did not. It's a single study, with lab stress rather than a real exam, but it fits the broader case for active recall: knowledge you've practiced pulling out is more likely to be there under pressure.

In practice:

- **Revise with practice questions and past papers**, not only rereading.
- **Start early enough** that you aren't learning new material the night before. An exam revision timetable helps.
- **Protect your sleep.** Tired attention makes everything harder, and the guide on sleep and studying explains why all-nighters tend to backfire.
- **Rehearse the real thing.** Do at least one practice paper under exam conditions: timed, no notes, at a desk. The exam then feels more familiar.

Writing out your worries: promising, then mixed

You may have heard that writing about your worries just before an exam can boost your score. That idea comes from a study by Ramirez and Beilock (2011), published in *Science*. Across two lab experiments and two classroom experiments, students who briefly wrote down their thoughts and worries about the test just before taking it did better than those who didn't, especially students who were usually anxious about tests. A later study with 80 students found that this kind of writing reduced the gap in math performance between more and less math-anxious students (Park et al., 2014).

The picture has become less clear since. A 2026 meta-analysis pulled together 21 studies of single-session expressive writing before a test, with 1,457 participants in total. It found a negligible, statistically non-significant effect on anxiety, and only a very small effect on test performance, which stopped being statistically significant once one extreme result was removed. The authors concluded that the research doesn't support single sessions of expressive writing as a treatment for test anxiety (O'Meara & Lovett, 2026). A randomized trial with 197 high school students in China, who wrote about past negative test experiences for ten minutes a day for three days, also found no reduction in anxiety and no improvement in exam scores (Liu et al., 2026).

What to take from this: writing out your worries before a test is quick and unlikely to hurt, and some people find it helps them settle. But it isn't a reliable fix, and it doesn't replace preparation or real support.

Reframing nerves as energy

Another approach is to change how you read your body's signals. A racing heart before an exam feels like a warning, but the same physical arousal also comes with excitement.

- **Reappraising arousal.** Jamieson and colleagues (2010) told students preparing for the GRE (a US graduate admissions test) that feeling aroused during a test can actually help performance. Those students did better on the math section of a practice test than students who weren't told this, and also scored higher on the math section of their real GRE one to three months later.
- **"I am excited."** Across several studies involving singing, public speaking and math, Brooks (2014) found that people who reframed their anxiety as excitement, for example by saying "I am excited" out loud, felt more excited and performed better than people who tried to calm down.

These are promising findings, but they come from a small number of studies, mostly in specific settings. Treat reframing as something worth trying, not a guaranteed result. And if your anxiety is severe, reframing it is not a substitute for help.

On the day

- **Eat something and arrive early**, so you aren't adding a rush to the nerves.
- **Skip last-minute cramming of new material.** A short look over key points is fine.
- **If your mind goes blank, move on.** Answer a question you can do, then come back. Recall often returns once you've settled.
- **Try a few slow breaths** before you start, if you find it calming.
- **Notice the racing heart and name it.** "This is my body getting ready." You don't have to feel calm to do well.

When to get help

Some nerves are normal. But if anxiety stops you from studying, keeps you awake, causes panic attacks, or makes you avoid exams altogether, it deserves proper support. Talk to a doctor, your school's counseling or disability service, or someone you trust. Many schools offer support for test anxiety and, in some cases, exam arrangements.

Doing this in Atheneum

- **Practice under exam-like conditions.** Quizzes in Review give you questions one at a time, without your notes in sight. Practice quizzes don't count for anything and can be retaken as often as you like, so a wrong answer costs nothing.
- **Plan your revision.** Put the exam in your calendar and your revision sessions on the task board, so you can see your preparation adding up. The guide on procrastination can help if avoidance is part of the problem.
- **Write out worries, privately.** If you want to try the writing exercise, the Notes tool is a quick place to do it.
- **Breathe.** The Pomodoro page has a breathing panel with box, 4-7-8 and calm patterns, designed for the moment before an exam. Use it if it helps you settle.

A quick start

1. Book one timed practice paper or quiz this week, under exam conditions.
2. Write down the exam date and plan revision so you finish new material at least a day before.
3. The night before, put sleep ahead of last-minute cramming.
4. Before the exam, if nerves rise, try telling yourself "I'm excited" and take a few slow breaths.

Nerves are normal. Preparation you trust is still the most reliable way to keep them in their place.

Read next: should you pull an all-nighter? and how to study for multiple-choice exams.

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Online: atheneum.app/guides/exam-anxiety-before-a-test · Updated 2026-10-25

GUIDE 21 · ORGANIZATION · 6 MIN READ

Concept Maps and Mind Maps: What the Evidence Says

What concept maps and mind maps are, what research says about how well they work, and how to get more out of them by drawing them from memory.

THE SHORT ANSWER

Research links concept maps to better retention on average, and making your own to a larger benefit than studying someone else's. But making a map with the text open did worse than practicing recall in a direct comparison. Draw maps from memory, label every link, then check them against your notes. Mind maps have much less evidence.

Concept maps and mind maps are everywhere in study advice: a topic in the middle, branches spreading out, arrows linking ideas. They can look like the perfect revision tool, since they show the big picture on a single page. The research is more interesting than that. Maps do help, on average, but *how* you use them makes a big difference. Used one way, a map is a pleasant summary. Used another, it is a strong test of what you know.

Concept maps and mind maps

The two are often treated as the same thing, but they differ.

- **A concept map** is a diagram of ideas (nodes) joined by labeled links. Each link says how two ideas relate: "photosynthesis *produces* glucose", "glucose *is used in* respiration". The labels carry much of the meaning, and a concept can link to many others, not just to the one above it.
- **A mind map** puts one topic in the center, with branches and sub-branches spreading out. Links are usually unlabeled, and the structure is mostly a tree.

Mind maps are quicker to make and good for brainstorming or a first overview. Concept maps take more thought, because you have to say *how* ideas connect, and that is often exactly what exams test.

What the research says

- **Maps help on average.** A meta-analysis of 55 studies with 5,818 students, from fourth grade to university, in subjects including science, psychology, statistics and nursing, found that using concept maps was associated with better retention of knowledge. The size of the benefit ranged from small to large depending on how the maps were used and what they were compared with (Nesbit & Adesope, 2006).
- **Making maps helps more than studying them.** A later meta-analysis of 142 effect sizes, covering 11,814 participants, found a moderate overall benefit of learning with concept maps. Creating them was associated with a larger benefit than studying maps someone else made, and the benefit

held in both STEM and non-STEM subjects (Schroeder et al., 2018).

- **Mind maps: less evidence.** There's much less research on mind maps specifically. In one small study, 50 medical students either used their usual study method or were trained to make mind maps of a short text. A week later, the mind map group recalled about 10% more facts, but the estimate was uncertain enough that the true difference could have been close to zero. The mind map group also felt less motivated by the technique (Farrand et al., 2002).

The catch: maps made with the book open

Those averages compare maps with many different alternatives. When a map is compared directly with practicing recall, the picture changes.

In a study published in *Science*, Karpicke and Blunt (2011) had students study science texts either by making concept maps with the text in front of them, or by practicing retrieval: recalling what they could from memory, without the text. On a later test, including questions that asked students to make inferences, the retrieval group did better. They even did better when the final test asked them to *draw a concept map*.

That doesn't mean maps are useless. It means a map drawn while copying from the page is mostly a study activity, not a test. The fix is simple: **draw the map from memory**.

Blunt and Karpicke (2014) tested exactly that. Students who made concept maps from memory, without the text, did better a week later than students who spent the time studying, and just as well as students who wrote paragraphs from memory. What mattered was retrieving the material, not the format.

How to make a useful concept map

Start from memory. Close your notes. Write the main topic in the middle and add every concept you can recall. This is blurting in diagram form.

Label every link. Don't just draw a line. Write a short phrase on it: *causes*, *is a type of*, *requires*, *is opposite to*. If you can't name the link, you've found something to check.

Add cross-links. Look for connections between branches. Cross-links are where real understanding shows, and where the why questions live.

Then check it against your notes. Use a different color for anything you missed or got wrong. Those are your gaps.

Redraw it a few days later. From memory again. The second map should need less red.

Keep it small enough to finish. One lecture or one topic per map. A map of a whole course becomes a poster, not a test.

For more on why pairing words and pictures can help, see the dual coding guide.

When to use a map, and when not to

- **Good for:** topics where relationships matter, such as systems, causes and effects, classifications, and processes with many parts.
- **Less good for:** lists of isolated facts, vocabulary, formulas or procedures. Flashcards and practice problems usually work better there.
- **Not a replacement for practice questions.** A map shows how ideas fit together, but exams also ask you to apply them. Combine maps with active recall in other forms.

Common mistakes

- **Copying the textbook into a diagram.** It feels productive, but you're rearranging, not remembering.
- **Unlabeled lines.** A line says two things are related; a label says how.
- **Spending the time on design.** Color and neatness don't add much. Use the time to recall and check.
- **Never checking.** A confident map with a wrong link teaches you the mistake.

Doing this in Atheneum

Atheneum doesn't have a concept-map or diagram tool, so draw your maps on paper or in any drawing app you already use. Atheneum helps with the recall and the checking.

- **Use Blurt Mode for the recall step.** Blurt Mode in Review hides your notes and runs a timer. Draw your map on paper from memory, then type its concepts and links into the blurt box and select **Check with Athena**: she reads the file and shows which key points you covered, partly covered and left out. She can miss or misjudge a point, so check the result against your own material.
- **Write the links as sentences.** In a notebook's Notes tab, turn each labeled link into a sentence ("Photosynthesis produces glucose"). It's a quick text record of your map that sits next to the lecture it came from.
- **Ask Athena about the connections.** Ask Athena how two concepts in your notebook relate, after you've drawn your own link. Compare her answer with yours and with your notes; she can be wrong.
- **Keep the source close.** Keep each subject's files in one notebook so you can check your map against the lecture straight away.

A quick start

1. Pick one lecture you've already studied.
2. Close your notes and draw a concept map from memory in ten minutes, with a label on every link.
3. Check it against your notes and add what's missing in a different color.
4. Redraw it from memory in three days and compare the two.

A map drawn from memory is a test you can see. That's what makes it worth the paper.

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Online: atheneum.app/guides/concept-maps-for-studying · Updated 2026-10-23

Handwriting vs Typing Notes: What the Research Actually Shows

Should you take notes by hand or on a laptop? What the famous 2014 study found, what replications and meta-analyses found since, and what matters more.

THE SHORT ANSWER

The evidence leans slightly toward handwriting, but less than the famous 2014 study suggested: two replications found no clear difference and meta-analyses disagree. What matters more is what you do: put ideas in your own words instead of transcribing, keep other tabs closed, and review and test yourself on your notes afterward.

"Take notes by hand, it's better for your brain" is one of the most repeated pieces of study advice of the last decade. It comes from a real study, and it has a real idea behind it. But the research since then is more mixed than the headlines, and the device you hold turns out to matter less than what you do with it.

The short version: handwriting may have a small edge, especially if you review your notes, but no tool makes up for transcribing everything and never looking at it again. This guide walks through the evidence, then shows how to get the benefit with either tool.

The study that started it

In 2014, Pam Mueller and Daniel Oppenheimer published "The Pen Is Mightier Than the Keyboard." Across three studies, students watched lectures and took notes either on a laptop (with no internet, so distraction wasn't the issue) or by hand. Students who typed performed worse on conceptual questions. Laptop users also wrote down more of the lecture word for word, and the authors argued that this was the problem: typing fast lets you transcribe without thinking, while writing slowly forces you to choose and rephrase (Mueller & Oppenheimer, 2014).

That explanation is appealing because it fits a broader idea in learning research: processing material, putting it in your own words, tends to beat copying it. The question is whether the handwriting result itself holds up.

What the replications found

Two direct replications tested the original design again.

- **Morehead, Dunlosky and Rawson (2019)** repeated the original procedure and extended it, adding a group that wrote on a digital tablet (an "eWriter") and a later, delayed test. Some trends favored longhand, but performance did not consistently differ between the groups. Their title asks the right question: how much mightier is the pen?

- **Urry and colleagues (2021)** ran a direct replication of the original first study. As in 2014, laptop users wrote more words overall and more words verbatim. But laptop users did not score worse on the quiz, and small meta-analyses across eight similar studies showed the same pattern. The authors concluded that the results do not support the idea that longhand improves immediate learning through better encoding.

One detail from the Urry replication is worth noticing: in both the original and the replication, students whose notes had more words tended to score better. Typing's speed is not only a weakness.

What the meta-analyses say

When researchers pool many studies, the answer depends on which studies go in.

- A 2022 meta-analysis by Voyer, Ronis and Byers, covering experimental studies of secondary and university students, found that the note-taking medium had little influence on achievement (Voyer et al., 2022).
- A 2024 meta-analysis of 24 studies of college students by Flanigan and colleagues found that taking and reviewing handwritten notes led to higher achievement, with a small effect (Hedges' g of about 0.25), even though typing produced far more notes. The authors themselves point out that earlier meta-analyses reached different conclusions, partly because they included different students, studies and outcome measures (Flanigan et al., 2024).

So the honest reading is: if there is a handwriting advantage, it's small, and it isn't settled. Anyone who tells you that typing ruins your learning, or that it makes no difference at all, is claiming more than the evidence shows.

The part nobody disputes: distraction

The 2014 study removed the internet on purpose. Real laptops don't. In a simulated classroom, Sana, Weston and Cepeda (2013) found that students who multitasked on a laptop during a lecture scored lower on a test than those who didn't, and students who simply sat in view of a multitasking peer scored lower too.

This is the biggest practical difference between pen and laptop. A notebook can't show you messages. If you type, the question isn't whether typing is worse; it's whether you can keep everything else closed for the whole lecture.

What matters more than the tool

Across this research, a few things predict learning better than the device.

Processing, not transcribing. Mueller and Oppenheimer's explanation, that verbatim copying is shallow, fits with what is known about learning, even if the device effect is shaky. Notes in your own words, with examples and connections, make you think during the lecture.

Reviewing the notes later. A 2006 meta-analysis of 33 studies by Kobayashi found that taking and then reviewing notes had substantial effects on learning compared with not doing so. Notes are a record you can study from, and that only helps if you actually go back.

Testing yourself on them. Rereading notes is a weak way to review them. Covering your notes and trying to recall what's in them is the stronger move; see active recall vs rereading.

How to choose and use your tool

Pick handwriting if the subject has many diagrams, equations or arrows between ideas, if you know you'll drift into other tabs, or if you find yourself typing every word the lecturer says.

Pick typing if the lecture moves fast and you need completeness, if you'll reorganize and search your notes later, or if handwriting is slow or painful for you. Typing is also a reasonable accommodation for many students, and nothing in this research says it's a bad one.

Whichever you choose:

1. **Paraphrase.** Write the idea, not the sentence. If you type, deliberately slow down and summarize instead of transcribing.
2. **Close everything else.** Full-screen your notes app, turn off notifications, and sit where other people's screens aren't in your view.
3. **Leave room for later.** A margin or a blank line after each section gives you space to add questions after the lecture. How to take lecture notes covers layouts like the Cornell method.
4. **Review the same day.** Fill gaps, fix unclear bits and write two or three questions the lecture answered.
5. **Test yourself within a few days.** Cover the notes and answer your own questions.
6. **Put the notes where you'll find them.** Handwritten pages can be photographed or typed up afterward; typing them up is itself a chance to process them again. Keep each subject's notes in one place, as in how to organize study notes.

Common mistakes

- **Treating the tool as the method.** Switching to paper won't help if you copy the slides word for word and never look at the page again.
- **Typing a transcript.** More words can help, but a full transcript is a sign you're recording, not thinking.
- **"Just checking one thing."** A single message during a lecture is enough to lose the thread, and it can distract the people around you.
- **Never reviewing.** Much of the value of notes comes from going back to them.
- **Rereading as the only review.** Recall beats rereading for the same time spent.

Doing this in Atheneum

Each notebook has a Notes section where you can write in Markdown, preview it, and import `.md`, `.markdown` or `.txt` files, so typed lecture notes (or handwritten notes you've typed up) can live next to the slides you uploaded for that subject. See Notes in a notebook and Notebooks. Your notes count as material: summaries, study guides, flashcard decks and quizzes made for the notebook read them along with your files, so you can turn a week's notes into a quiz and test yourself on them instead of rereading.

A quick start

1. For your next lecture, choose one tool and close everything else on the device.
2. Write ideas in your own words, leaving a line or margin after each section.
3. The same day, spend ten minutes filling gaps and writing three questions in the margin.
4. Two or three days later, cover the notes and answer those questions from memory.
5. After a few weeks, compare how well each approach worked for you on real quizzes, not how it felt.

The pen versus keyboard debate is real but small. Thinking while you take notes, and studying from them afterward, is where most of the benefit is.

If you're learning from a textbook rather than a lecture, the same ideas apply to reading: see how to read a textbook.

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Online: atheneum.app/guides/handwriting-vs-typing-notes · Updated 2026-10-23

GUIDE 23 · UNDERSTANDING · 7 MIN READ

How to Read a Textbook So It Actually Sticks

How to read a textbook chapter and remember it: preview, read with questions, explain as you go, then close the book and recall. What the evidence supports.

THE SHORT ANSWER

Preview the chapter, then read a section at a time with a question in mind, explaining to yourself why each idea is true. After each section, close the book and recall the main points, then check. Rereading and heavy highlighting do little on their own; recalling what you read, with feedback, is what has the best evidence.

You read the whole chapter, every word, maybe twice. You highlighted the important parts. A day later you can't say what it was about. That isn't a sign you're bad at reading; it's what usually happens when reading is the only thing you do with a text.

The fix isn't to read more slowly or more times. It's to read in short sections and do something with each one: ask why it's true, then close the book and try to recall it. This guide explains what the research supports, where popular methods go beyond the evidence, and a routine you can use on your next chapter.

Why reading alone doesn't stick

Reading is a recognition task. The words are on the page, they make sense as you go, and that feeling of understanding is easy to mistake for learning. The test comes later, when the page is gone.

Rereading feels like a remedy, but on its own it adds surprisingly little. In four experiments with textbook chapters and a magazine article, Callender and McDaniel (2009) found that reading a text a second time generally did not significantly improve performance on multiple-choice questions, short-answer questions or summaries, compared with reading it once. A large review of ten common study techniques by Dunlosky and colleagues (2013) rated rereading and highlighting as low utility: students use them heavily, but they don't consistently boost performance. The same review rated summarization low too, because it helps some students on some tasks but depends heavily on how well it's done.

None of this means reading is useless. You have to read a chapter to learn from it. It means the reading needs to be followed by something more active.

What the evidence supports

Recall after reading. In a well-known 2006 study, Roediger and Karpicke had students read prose passages and then either reread them or try to recall them from memory. Rereading did better on a test five minutes later, but recall led to substantially better retention on tests two days and a week later, even though the rereaders felt more confident. Retrieval practice is one of the two techniques the Dunlosky review rated high utility. For more on why, see active recall vs rereading.

A tested reading routine: read, recite, review. McDaniel, Howard and Einstein (2009) tested a simple routine with college students: read a passage, put it away and recite (say or write) everything you remember, then reread it to check. Compared with rereading, this improved free recall both right away and a week later, and on longer engineering passages it beat rereading on multiple-choice and problem-solving questions. It matched note-taking on those questions while taking less study time. It's a small set of lab experiments, not a semester-long trial, but it's direct evidence for the core of the routine below.

Explaining to yourself as you read. In a study by Chi and colleagues (1994), eighth graders reading a text on the circulatory system who were prompted to explain each line to themselves gained more understanding than students who read the text twice, and those who explained the most built the most accurate picture of how the system works. The study was small (24 students), but a 2018 meta-analysis of 64 reports found that prompting learners to self-explain had an average effect of about half a standard deviation ($g = 0.55$) across a range of settings (Bisra et al., 2018). The Dunlosky review rated self-explanation moderate utility, noting that it hadn't yet been tested enough in real classrooms. The elaborative interrogation and self-explanation guide goes deeper.

What about SQ3R?

SQ3R (survey, question, read, recite, review) and its variants are the reading methods most often taught. Its pieces line up with the evidence above: reciting is retrieval practice, and questioning is close to self-explanation. But the full five-step method has rarely been tested as a package against simpler alternatives, so claims that it's "proven" go further than the research. The honest approach is to keep the parts with evidence behind them (recall and explaining) and treat the rest (previewing, turning headings into questions) as sensible habits that make those parts easier.

How to read a chapter, step by step

1. Preview (5 minutes). Skim the headings, the summary at the end, the figures and any bold terms. Read the end-of-chapter questions if there are any. You're building a map, not learning yet. This is a habit, not a proven technique, but it tells you what the sections are and where the chapter is going.

2. Turn headings into questions. Before each section, ask what it should answer. "Enzyme kinetics" becomes "What controls how fast an enzyme works?" Reading to answer a question keeps you looking for the point instead of passing your eyes over lines.

3. Read one section at a time. A section is a few pages, or one heading. Don't highlight on the first pass; it's hard to know what's important until you've read the whole section.

4. Explain as you go. When a claim seems important, stop and ask why it's true, or how it connects to the previous section. For a worked example, explain each step before reading the book's explanation. If you can't explain it, that's the part to reread.

5. Close the book and recall. At the end of each section, cover the page and write or say the main points from memory: the key ideas, the terms, how they connect. A few lines is enough. This is the "recite" step, and it's the one with the strongest evidence.

6. Check and fix. Open the book and compare. Note what you missed or got wrong, and reread only those parts. Now is the time to mark the text if you want to, sparingly, at the points you missed.

7. Test yourself later. A day or a few days after, try to recall the whole chapter from the headings alone, or answer the end-of-chapter questions without looking. Writing everything you remember about the chapter on a blank page is a good format; see the blurting method.

Common mistakes

- **Highlighting on the first read.** Most of the page ends up yellow, and highlighting replaces thinking about what matters.
- **Reading the chapter twice instead of testing once.** For the same time, recall and checking does more than a second read.
- **Copying sentences into notes.** Notes that repeat the book are rereading with extra steps. Write the idea in your own words, from memory where you can. Handwriting vs typing notes covers why processing matters more than the tool.
- **Saving all the checking for the end.** Recalling after each section catches confusion early, before later sections build on it.
- **Trusting the feeling of fluency.** If the chapter "made sense," test whether you can explain it with the book closed.

Doing this in Atheneum

Upload the chapter (PDF or DOCX) to the subject's notebook, and Atheneum writes a file summary with key concepts, main points, key terms and revision questions (see Notebooks and Summaries and study guides). Read the chapter first and use the summary as a check on your own recall, not as a replacement for reading. For the recall step, open Blurt Mode, pick the file, write everything you remember with it hidden, and Athena shows which key points you covered, partly covered or left out. A few days later, generate a quiz from the notebook to test yourself across chapters. AI-generated summaries and quizzes can contain mistakes, so check them against the book.

A quick start

1. Pick one chapter you need to learn this week.
2. Spend five minutes previewing it, and write the headings as questions.
3. Read one section, then close the book and write three to five lines from memory.
4. Open the book, check, and reread only what you missed.
5. Repeat for each section, then two days later write down everything you remember about the whole chapter.

Reading gets the material in front of you. Recalling it is what makes it stay.

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Online: atheneum.app/guides/how-to-read-a-textbook · Updated 2026-10-23

GUIDE 24 · FOCUS · 9 MIN READ

Music While Studying: Does It Help or Hurt?

What research says about studying with music or background noise: why lyrics hurt reading, what happened to the Mozart effect, and how to pick sound that helps.

THE SHORT ANSWER

It depends on the task. Background speech and songs with lyrics reliably make reading and memorizing a little worse, and even instrumental music and noise cost something on average. The Mozart effect did not hold up. For hard verbal work, silence is safest; for routine work or a noisy room, quiet instrumental music or steady sound is a reasonable choice.

Plenty of people can't study in silence, and plenty of others can't study with anything playing. Both groups tend to assume the other is doing it wrong. The research is clearer than the arguments: background sound is not neutral. Speech and songs with lyrics get in the way of reading and memorizing, and the famous "Mozart effect" turned out to be much smaller and more ordinary than it was sold as.

The bottom line: for work that is mostly words (reading, writing, learning definitions, memorizing), silence or steady sound without words is the safer bet. For routine work, or to cover up a noisy room, quiet instrumental music or a steady background sound is fine for many people. Pick the sound to suit the task, not the other way round.

Why words in the background get in the way

The clearest finding in this area is about speech. In classic experiments by Salamé and Baddeley, people saw a list of digits and had to recall them in order. Speech playing in the background disrupted their recall, even though they were told to ignore it and even when it was in a language they didn't understand. Psychologists call this the **irrelevant speech effect**, or more broadly the **irrelevant sound effect**.

A 1989 study by the same researchers tested music. Vocal music disrupted memory for the digits more than instrumental music did. In one experiment instrumental music was not reliably worse than silence, but in another it was, and steady noise, even noise rising and falling like speech, was no more disruptive than silence (Salamé & Baddeley, 1989). The general picture: sound that is speech-like, and especially sound with words, competes with the part of memory you use to hold words in mind.

Reading shows the same pattern. A 2018 meta-analysis pooled 65 studies of reading with background sound. Noise, speech and music all had a small but reliable negative effect on reading performance, for adults and children alike. Intelligible speech and music with lyrics caused the most disruption (Vasilev, Kirkby & Angele, 2018).

A study by Perham and Currie (2014) asked whether liking the music changes this. Students did a reading comprehension test, similar to a standardized admissions test, in quiet, with instrumental music, with lyrical music they liked, or with lyrical music they disliked. Scores were best in quiet and with

instrumental music, and worst with lyrics, whether people liked the songs or not. Liking the song didn't protect them.

What the big reviews say about background music

Studies of background music in general point in different directions, which is why the topic stays argued over. A meta-analysis by Kämpfe, Sedlmeier and Renkewitz (2011) tried to sort this out across many kinds of task. Averaged over everything, background music had roughly no effect. But that average hid opposite effects underneath: compared with no music, background music disturbed reading and had small harmful effects on memory, while it improved mood and helped performance in sports.

So "music helps" and "music hurts" are both true, for different things. For a run, music can help. For learning from a textbook, the evidence leans the other way.

What happened to the Mozart effect

In 1993, a short paper in *Nature* reported that students did better on a spatial reasoning task after listening to a Mozart sonata for ten minutes than after silence or relaxation instructions (Rauscher, Shaw & Ky, 1993). The finding was quickly turned into products and advice promising that classical music makes you smarter.

It didn't survive the follow-ups. In 1999, Christopher Chabris summarized 16 studies in *Nature* and argued that any gain was small, limited to one kind of spatial task, and better explained by the listeners being more aroused and in a better mood (Chabris, 1999). A 2001 experiment tested that directly: a lively Mozart piece improved spatial scores, a slow, sad Albinoni piece did not, and once differences in arousal and mood were accounted for, the Mozart effect disappeared (Thompson, Schellenberg & Husain, 2001).

The largest review, by Pietschnig, Voracek and Formann (2010), pooled about 40 studies with more than 3,000 participants and concluded there is little evidence left for a specific, performance-enhancing Mozart effect. They also found signs of publication bias, and found that studies from the original research group reported noticeably larger effects than studies by other labs.

What's left is modest and not specific to Mozart: music you enjoy can lift your mood and alertness for a while, and a better mood can help a little on some tasks. Note that the Mozart studies played music *before* the task, not during it.

Does personality matter?

Some people really do seem to cope with background music better than others. One commonly cited line of research looks at introverts and extraverts. In a small study by Furnham and Bradley (1997), with 10 introverts and 10 extraverts, pop music hurt immediate recall for both groups. After a delay, introverts who had studied with music remembered less than extraverts in the same condition, and introverts also did worse on reading comprehension with music playing.

This is a small, older study, so treat it as a hint rather than a rule. It fits a reasonable idea: if you find background sound draining, trust that and study in quiet. And whatever your personality, the reading and memory costs above were found on average, across ordinary students.

Why it works this way

- **Words compete with words.** When you read or memorize, you are holding language in mind. Lyrics and speech push language at the same system, which makes it harder to keep your own words in order.
- **Changing sound grabs attention.** Sound that varies a lot from moment to moment is harder to tune out than a steady background.
- **Mood is the real benefit.** What music does reliably is change how you feel. That can make starting easier and a long session less grim, which matters, but it isn't the same as learning faster.

How to choose your study sound

Match the sound to the task.

Task	Better choice
Reading new material, writing, memorizing words or definitions	Silence, or a steady sound with no words
Solving practice problems you already know how to do	Quiet instrumental music or a steady sound, if you prefer it
Routine work (tidying notes, making a diagram neat, formatting)	Whatever helps you keep going
A noisy room you can't leave	A steady sound to cover the noise, at low volume

Skip the lyrics for verbal work. This includes podcasts and videos playing in the background. If you can follow the words, they are costing you something.

Keep it low. Background sound should stay in the background. If you find yourself listening to it, it's too loud or too interesting.

Use steady sound to mask worse sound. If the choice is between a roommate's conversation and quiet rain, the rain is likely the smaller cost, since speech you can understand was among the most disruptive sounds in the studies above. This is a practical judgment, not a tested study prescription.

Use music for starting and for breaks. Since mood is where music reliably helps, play something you enjoy while you set up or during a break, then turn it down or off when the hard part starts. The Pomodoro technique gives you natural points to do this.

Test it on yourself honestly. Do one session in silence and one with your usual sound, then check what you actually remember with a few questions from memory. How a session *felt* is not a good guide.

Common mistakes

- **Treating "I like it" as "it helps."** In the reading study above, liked lyrical music hurt comprehension as much as disliked lyrical music.
- **Studying with a show or video on.** Speech you can follow is the most distracting background there is.
- **Hunting for the perfect playlist.** Searching and skipping tracks is a distraction of its own, and it can turn into a way of putting off the work. The guide on procrastination covers that pattern.
- **Assuming classical music makes you smarter.** The Mozart effect did not hold up.

Doing this in Atheneum

The Music page opens on a sound mixer: nine real recordings, including rain, wind, waves, a stream, a fire and a café, each with its own level, plus a master volume. Eight presets such as "Rainy library" and "Seaside" give you a starting point, and you can save your own mixes in your browser. For reading and memorizing, a mix without the café's chatter keeps words out of the background. The mix keeps playing while you use the rest of the app, including the Pomodoro timer. The **Streams** tab also plays long YouTube streams of lo-fi, noise, nature and classical music if you'd rather have music for routine work. See the sound mixer and music streams for details.

A quick start

1. Look at what you need to do today and label each task "words" (reading, writing, memorizing) or "routine."
2. For the words tasks, study in silence or with a steady sound with no voices, at low volume.
3. Save music you enjoy for routine tasks and for your breaks.
4. If your room is noisy, cover it with a steady sound rather than a song you know the words to.
5. At the end, close your notes and write down what you remember, so you judge the session by what stuck. If your phone is the bigger distraction, read phones and studying next.

Background sound can make studying more pleasant. Just keep the words out of your ears when you need them in your head.

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GUIDE 25 · FOCUS · 8 MIN READ

Phones and Studying: How Your Phone Affects Focus

What research says about phones, notifications and multitasking while studying, the contested brain drain studies, and simple ways to keep your phone away.

THE SHORT ANSWER

Using your phone while studying splits your attention, and students who text or use social media while studying tend to report lower grades, though those studies are correlational. Even a notification you ignore can disrupt a demanding task. Whether a silent phone nearby hurts is contested. Put it out of reach, silence notifications and check it at breaks.

Most students study with a phone within arm's reach. A message arrives, you glance at it, you answer, and a minute later you are back to the page, or you think you are. The research on this is less dramatic than some headlines, but the core point holds up: checking and using your phone during study costs attention, and notifications cost some even when you don't pick the phone up.

The bottom line: you don't need a perfect phone detox. You need the phone out of reach while you work, notifications off, and a set time to check it. That is cheap to do and removes most of the problem.

What happens when you switch back and forth

Switching between your notes and your phone feels like doing two things at once. In practice, your attention is moving back and forth, and each return to the work takes a moment to pick up where you left off.

How often does that happen? In a 2013 study, observers watched 263 middle school, high school and university students study at home for 15 minutes, noting every minute what they were doing. On average, students stayed on task for less than six minutes before switching, most often to technology such as texting or social media. Students who used Facebook during the session had lower grade point averages (Rosen, Carrier & Cheever, 2013).

Other studies point the same way:

- A survey of 1,839 university students found that using Facebook and texting while doing schoolwork were linked to lower overall GPA (Junco & Cotten, 2012).
- An earlier survey found that students who used Facebook reported lower grades and fewer hours studying per week than students who didn't (Kirschner & Karpinski, 2010).

These studies are **correlational**. They can't show that the phone caused the lower grades. Students who struggle, or who are less interested in a course, may also be the ones who reach for their phones more. Treat them as a warning sign, not proof.

What experiments show

Some experiments get closer to cause and effect.

In a simulated lecture, students who were told to multitask on a laptop scored lower on a later test of the lecture than students who didn't. Students who simply sat where they could see a multitasking classmate's screen also scored lower (Sana, Weston & Cepeda, 2013).

In a real college course, Glass and Kang (2019) allowed electronic devices in half of the lectures and banned them in the other half. Device use did not lower scores on quiz questions asked during class, but it did lower later exam scores on that material. Scores were lower for lectures where devices were allowed even among students who said they hadn't used one, which suggests the distraction spreads to the people around you.

These studies are about lectures, not studying alone, but the lesson carries: understanding something in the moment doesn't mean it sticks if your attention was split while you learned it.

Notifications cost attention even if you ignore them

You might think a notification you ignore costs nothing. A 2015 experiment suggests otherwise. Participants did a task that demands steady attention. Some of them received phone calls or text notifications on their own phones during the task, without answering. Their performance dropped, and the drop was comparable to what earlier studies found when people actually used their phones (Stothart, Mitchum & Yehnert, 2015). The authors' explanation is that a buzz or ping starts you thinking about something else, even if your hands stay still.

Does a phone just sitting there drain your brain?

This is the part of the story to be careful with.

In 2017, Ward and colleagues published two experiments testing what they called the **brain drain** hypothesis. Participants left their phones on the desk, in a pocket or bag, or in another room, then took tests of working memory and reasoning. The closer the phone, the worse people did, and the cost was largest for people who said they depended most on their phones. The study was widely reported as "your phone makes you dumber just by being there" (Ward, Duke, Gneezy & Bos, 2017).

Later work has not backed up the strong version:

- A pre-registered direct replication of Ward's second experiment, using the same tasks and conditions, found no difference between phone locations (Ruiz Pardo & Minda, 2022).
- A meta-analysis of 56 studies with about 7,000 participants found one small negative effect of a phone's presence, on working memory capacity, and no reliable effect on the other abilities tested. The author noted that the effect was smaller than originally claimed and that many studies were underpowered and used different methods, so the evidence can't settle the question either way (Parry, 2024).

So: a silent phone in view *might* cost a little working memory. It probably doesn't cost as much as the original headlines said. Fortunately, the advice is the same either way, because putting the phone out of reach also removes the notifications and the temptation to check, which have clearer evidence behind them.

Why your phone is so hard to ignore

- **Every check is a small task switch.** Even a quick look means leaving your work and finding your place again.
- **Notifications start new thoughts.** A ping makes you wonder who it is, which pulls your mind off the page whether or not you look.
- **Checking is easy and rewarding.** Something new might be there, which is exactly what makes it tempting during hard or boring work. That's also why the phone becomes a way to put off studying, which the guide on procrastination covers.

How to keep your phone from taking over

Put it out of reach, ideally in another room. If you have to get up to check it, you'll check it much less. A bag across the room is the next best thing. Out of sight beats face down.

Turn notifications off while you study. Use your phone's do-not-disturb or focus mode. If you're worried about missing something urgent, most phones let certain contacts through.

Check at set times, not whenever it buzzes. In a field experiment with 237 people, those whose notifications were batched three times a day felt more attentive and less stressed than those who got them as usual, while those who got no notifications at all reported more anxiety and fear of missing out (Fitz et al., 2019). That study measured well-being, not learning, but it suggests checking in planned batches is easier to live with than going cold turkey. Study breaks are a natural time to check.

Use your phone's own limits. Built-in screen-time tools and app timers can lock the apps you lose time on during study hours. They don't stop you, but they add a step and make you notice.

Tell people. If friends know you're studying until a set time, you'll worry less about missing their messages.

Keep what you need off the phone. If you use your phone for a timer, flashcards or music, the distractions are one swipe away. Where you can, use a different device or a paper list for those.

Common mistakes

- **Face down on the desk.** It's still in reach and the notifications still land.
- **"Just checking the time."** One look at the lock screen shows you everything else too.
- **Answering messages "quickly."** Each reply invites another, and getting back into the work takes longer than it seems.

- **Going all-or-nothing.** A plan you can keep, like checking at every break, beats a total ban you abandon on day two.
- **Leaving a laptop full of other tabs open.** The same switching costs apply to a browser full of chats and feeds. Close what you don't need for the task.

Doing this in Atheneum

The Pomodoro timer runs in your browser, so the timer that tells you when to break doesn't have to be on your phone: 25-minute focus rounds, short breaks, and a longer break after every fourth round. Those breaks are your planned times to check messages.

The timer keeps running in a top-bar chip while you use other pages, and can alert you when a round ends (Pomodoro timer). If you notice yourself reaching for your phone because you're stressed rather than bored, the **Breathing** exercise and **Panic mode** on the Pomodoro page offer a minute of guided breathing instead (Breathing and panic mode).

Atheneum doesn't block apps or websites, so use your phone's own focus mode and app timers for that. If background sound helps you settle, see music while studying for what to play.

A quick start

1. Before your next session, turn on do-not-disturb and put your phone in another room or a bag across the room.
2. Start a 25-minute focus round. Don't touch the phone until it ends.
3. At the break, check messages for a few minutes, then put the phone back before the next round.
4. Set an app timer on the one app that eats most of your study time.
5. After a week, notice how many rounds you finished compared with before. For more on structuring rounds and breaks, see the Pomodoro technique guide.

Your phone doesn't have to go. It just has to wait its turn.

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GUIDE 26 · MEMORY · 8 MIN READ

Does Highlighting Work? What the Research Says

Is highlighting a good way to study? What reviews and a 2022 meta-analysis found, why it feels useful, and how to make highlights earn their keep.

THE SHORT ANSWER

On its own, not much. A 2013 review rated highlighting low utility, and a 2022 meta-analysis found highlighting your own text helped memory modestly but not comprehension, and helped college students but not school students. Highlight sparingly, then turn each highlight into a question you answer with the page closed.

Highlighting is probably the most common study habit there is. You read with a pen in hand, color the parts that look important, and come back later to read the colored parts again. It feels productive: the page fills up, and you can see your progress.

The research is less kind. Reviews of study techniques rate highlighting as one of the least useful ones, and a large 2022 meta-analysis found that highlighting your own text gives a modest boost to remembering facts and little to understanding them. Highlighting isn't harmful in itself, but it's a weak place to stop. This guide covers what the evidence shows, why highlighting feels better than it is, and how to turn it into something that works.

What the research says

The 2013 review: low utility

In 2013, John Dunlosky and colleagues reviewed ten common study techniques and rated how useful each one was across different students, materials and kinds of test (Dunlosky et al., 2013). They chose highlighting and rereading partly because students report relying on them so heavily. Highlighting and underlining were rated **low utility**, alongside rereading and summarizing. Practice testing and spaced practice came out on top.

In a shorter version of the review written for teachers, Dunlosky summarized the highlighting evidence plainly: compared with simply reading a text, highlighting had failed to help a wide range of learners, including Air Force trainees, children and undergraduates (Dunlosky, 2013). He also described one study in which students who highlighted did worse on a comprehension test that required making inferences across different parts of the text. His suggested explanation: by focusing on individual sentences, they may have spent less time thinking about how ideas connected. His advice wasn't to throw highlighters away, but to treat highlighting as "only the beginning of the journey."

The 2022 meta-analysis: a small effect on memory, not comprehension

A meta-analysis pools many studies to estimate an average effect. Ponce, Mayer and Méndez (2022) did this for highlighting, combining 36 published articles from 1938 to 2019 (85 effect sizes). They separated two situations:

Situation	Memory tests	Comprehension tests
You highlight the text yourself	Improved (average effect 0.36)	No reliable improvement (0.20)
The text comes already highlighted by an instructor	Improved (0.44)	Improved (0.44)

They also found that highlighting your own text helped college students (0.39) but not school students (0.24).

That gives a more nuanced picture than "highlighting doesn't work." Marking a text does seem to help you remember the marked facts a little, at least for older students. But it doesn't reliably help you understand the material, which is what most exams test once you're past recalling definitions. And the best results came when someone who already knew what mattered did the highlighting, which points to the real problem: choosing what to mark.

A few honest limits. The effects are averages across very different studies, texts and tests. Most studies compare highlighting with plain reading, not with stronger methods like self-testing, so "it helps a bit compared with just reading" doesn't mean it's a good use of your time compared with the alternatives.

Why highlighting feels like learning

Highlighting feels useful for the same reason rereading does. When you go back over colored text, it looks familiar and reads smoothly, and that ease feels like knowing. A review of how students manage their own learning describes how people's sense of how well they've learned is swayed by this fluency, which leads them to misjudge and mismanage their study (Bjork, Dunlosky & Kornell, 2013).

You can see the same pattern in the testing-effect research. In Roediger and Karpicke's 2006 study, students who restudied a passage felt more confident about remembering it than students who practiced recalling it, yet the recall group remembered more after two days and after a week (Roediger & Karpicke, 2006). Familiarity and memory are not the same thing.

Students' habits reflect this. In a survey of 177 college students, a majority said they studied by rereading their notes or textbook, and relatively few tested themselves (Karpicke, Butler & Roediger, 2009). The authors suggested that students experience illusions of competence while studying. There's a separate guide on why you think you know it, and how to check.

There's a practical problem too. Highlighting asks you to decide what's important while you're reading something for the first time, which is when you're least able to judge. That's how pages end up mostly yellow.

When highlighting can help

The evidence leaves room for highlighting done well:

- **When you've learned how to choose.** In a training experiment with 45 university students, those taught a strategy for identifying and highlighting the important information in a text learned more than untrained students, and those trained in both highlighting and monitoring their own strategy use did best (Leutner, Leopold & den Elzen-Rump, 2007). It's one small study, but it fits the meta-analysis: highlighting works better when the selection is good.
- **When the highlighting is a pointer, not the end point.** A highlight that marks "make a question about this" is useful. A highlight that marks "read this again later" mostly sets up more rereading.
- **When someone who knows the subject chose what to mark.** Instructor-provided cues helped both memory and comprehension in the meta-analysis. Pay attention to what your teacher emphasizes, bolds or repeats.

How to highlight so it's worth it

1. **Read a section first, then mark.** Read a whole paragraph or section before you pick up the pen. You'll judge what matters far better once you've seen where the section is going.
2. **Mark very little.** Aim for a phrase or a sentence per paragraph at most: the main claim, a definition, or a key step. If everything is highlighted, nothing is.
3. **Write a question beside each mark.** In the margin or in your notes, turn the highlight into a question: "What are the three causes of…?", "Why does X lead to Y?" Questions that ask *why* or *how* push you toward connections, which is what highlighting alone tends to miss.
4. **Close the book and answer the questions.** This is the step that does the work. Answer from memory, then check against the page.
5. **Make cards from the ones you missed.** Turn the questions you got wrong into flashcards and review them over the following days and weeks. The guide on spaced repetition explains how to schedule them.
6. **Use your highlights as an index, not a summary.** When you come back to the chapter, use the marks to find the questions, not to reread the colored text.

For a full method for reading a chapter, from previewing to recalling each section, see how to read a textbook.

Common mistakes

- **Highlighting on the first pass.** Everything looks important the first time through.

- **Highlighting instead of thinking.** Coloring a sentence can feel like processing it. Ask yourself what the sentence means and why it's true before you mark it.
- **Rereading the highlights as revision.** That's rereading with fewer words. It builds familiarity, not recall.
- **Using several colors for categories.** A color system can be a way to organize a page, but the time spent choosing colors isn't time spent remembering anything.
- **Never testing.** If your study never involves answering a question with the page closed, you don't know what you know.

Doing this in Atheneum

- **Turn highlights into questions in a note.** Open the notebook for the subject and write your margin questions in a notebook note. Notes count as source material, so summaries, flashcards and quizzes made for the notebook read them along with your files.
- **Make flashcards.** Generate a flashcard deck from the notebook, or write your questions and answers as two columns in a spreadsheet saved as CSV (or in Anki) and import them as a deck. Studying cards uses spaced repetition, so the ones you miss come back sooner.
- **Check what you remember.** Blurt Mode has you write everything you remember about a file with your notes hidden, then shows which key points you covered, partly covered or left out. A quiz on the notebook does the same with questions.

AI-made cards and quizzes can contain mistakes, so check them against your own material.

A quick start

1. Take the next chapter you need to study and read the first section without a pen.
2. Go back and highlight one sentence per paragraph at most.
3. Beside each highlight, write a question that the sentence answers.
4. Close the book and answer every question, then check.
5. Make flashcards from the questions you missed, and answer them again in two days.

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GUIDE 27 · MEMORY · 8 MIN READ

Why You Think You Know It (and How to Check)

Why material feels learned before it is, what research on judgments of learning shows, and simple ways to check what you really know before the exam does.

THE SHORT ANSWER

Material feels learned when it is familiar, and familiarity is a poor guide to what you will recall later. Judgments made right after studying tend to be off, while judgments made after a delay, from a cue alone, are much more accurate. So test yourself, predict before you check, wait before judging, and track what you got wrong.

Every student knows the feeling: you went through the chapter, it all made sense, you were sure you had it. Then the exam asks a question you can't answer, about something you remember reading. You didn't forget it overnight. You probably never knew it the way you thought you did.

Psychologists study this under the name *metacognition*: how people judge their own learning. The bottom line from that research is that your sense of "I know this" is often wrong in predictable ways, and it tends to be most wrong right after studying. The good news is that the fix is simple. Stop asking yourself whether you know something, and start checking.

Why studying makes you feel ready too early

You judge with the answer in front of you

When you study, you judge your learning while the material is right there. In an exam, it isn't. Koriat and Bjork (2005) described this mismatch: judgments of learning are made in the presence of information that will be missing at test, and failing to discount it creates a sense of competence during learning that proves unwarranted at test. A definition seems obvious when you're reading it. Producing it from a blank page is a different task.

Familiar feels like known

Rereading makes text flow more easily the second time, and that ease feels like knowledge. A review of how students manage their own learning describes how judgments of learning are swayed by this sense of fluency, which leads people to misjudge and mismanage their study (Bjork, Dunlosky & Kornell, 2013). In Roediger and Karpicke's 2006 study, students who restudied a passage were more confident they would remember it than students who practiced recalling it, but on tests two days and a week later the recall group remembered more (Roediger & Karpicke, 2006). Highlighting builds the same kind of familiarity; see does highlighting work?

Performance during study isn't learning

How well you do while practicing is a weak guide to what will last. A review by Soderstrom and Bjork (2015) brings together evidence that improvements in performance during practice can fail to produce lasting learning, that some study conditions have opposite effects on short-term performance and long-term learning, and that people often take their performance while studying as a reliable guide when it isn't. Conditions like these, which slow you down now but help later, are often called *desirable difficulties*; spacing study out is the classic example, and mixing topics and testing yourself are others discussed in the same research.

Students choose what feels effective

Because of all this, the methods that feel best are often not the ones that work best:

- In a flashcard study, studying one large stack (which spaces out each card) was more effective than studying the same cards in smaller stacks (which crams each card's repetitions together) for 90% of participants. Yet after the first session, 72% believed the cramming-style stacks had worked better (Kornell, 2009).
- When people learned painters' styles, mixing artists together beat seeing each artist's paintings in a block, but participants rated blocking as more effective even after their own test results showed the opposite (Kornell & Bjork, 2008). The guide on interleaving covers this in more detail.
- In a survey of 177 college students, a majority said they studied by rereading, and relatively few tested themselves (Karpicke, Butler & Roediger, 2009).

Why it matters: overconfidence costs you study time

A misjudgment isn't harmless. If you think you know something, you stop studying it. Dunlosky and Rawson (2012) had college students learn key-term definitions, try to recall them, and judge how correct each of their answers was, studying until they had judged each definition correct several times. In both of their studies, students whose self-judgments were more accurate remembered more on a test two days later. In one of the studies the researchers changed how accurate students' judgments were, rather than just observing it, which is why the paper argues that overconfidence produces underachievement: if you wrongly judge an answer as right, you stop practicing it too soon.

What makes your judgments more accurate

Wait before you judge

The best-known finding here is the **delayed-JOL effect**. Nelson and Dunlosky (1991) found that people's judgments of learning, which are usually not very accurate, became extremely accurate when they were made a short while after study instead of immediately, with only the cue (for example, the word whose pair you had to recall) shown. A 2011 meta-analysis of the effect, covering 4,554 participants, found that

delaying judgments reliably and substantially improved how well people could tell which items they would and wouldn't remember (Rhodes & Tauber, 2011). Delayed judgments also gave a small extra benefit to memory itself.

The likely reason: when you judge later with only a cue, you more or less try to retrieve the answer, and whether it comes is good evidence about whether it will come in the exam. So the practical form of this finding is simply to try to recall, after a delay, and judge from what happens.

Let mistakes surprise you

Being confidently wrong is uncomfortable, but it's useful. Butterfield and Metcalfe (2001) found that errors people made with high confidence were the most likely to be corrected on a later retest after they saw the right answer, the opposite of what the researchers expected. This is called the *hypercorrection effect*. The lesson isn't to aim for confident errors. It's that checking your answers against the correct ones, especially the ones you were sure about, is time well spent.

Test, don't inspect

Looking at a page and asking "do I know this?" mostly measures familiarity. Answering a question with the page closed measures recall. Active recall is both one of the best-supported ways to learn and the most honest way to find out what you know.

How to check what you know, step by step

1. **Turn the material into questions.** For each section, write a few questions that an exam could ask, including *why* and *how* questions, not only definitions.
2. **Wait before testing.** Leave at least some time between studying a section and testing yourself on it, ideally until the next day. Testing straight after reading tells you what's in short-term memory.
3. **Predict, then answer.** Before each question, or before a practice quiz, note how confident you are or what score you expect. Then answer with nothing in front of you.
4. **Check against the source.** Mark each answer right, partly right or wrong. Be strict: "I sort of knew it" is wrong. Compare your prediction with your actual score.
5. **Pay attention to confident misses.** Anything you were sure of and got wrong goes to the top of your list. Look at the correct answer carefully.
6. **Keep a list of what you got wrong.** Write down the questions you missed, and come back to them over the following days. Spaced repetition is a good way to schedule them.
7. **Repeat until predictions match results.** When your expected scores line up with your real ones, your sense of what you know is becoming trustworthy, at least for that material.

Common mistakes

- **Judging straight after reading.** This is when the feeling of knowing is least reliable.
- **Peeking before committing.** Seeing the answer and thinking "yes, that's what I'd have said" isn't a test. Commit to an answer first.

- **Marking yourself generously.** A half-remembered answer marked as correct is the overconfidence the research warns about.
- **Studying only what feels shaky.** Fine, but test what feels solid too. Confident errors live there.
- **Treating difficulty as failure.** Spaced and mixed practice feel worse while you're doing them. That's expected, and it's not evidence that they aren't working.

Doing this in Atheneum

- **Quizzes as a check.** A quiz on a notebook shows questions one at a time with your notes out of sight, and the results list every question with your answer, the correct answer when you got it wrong, and feedback. Write down your predicted score before you start and compare.
- **Rate flashcards honestly.** When you study a deck, answer in your head before flipping, then rate **Again**, **Hard**, **Good** or **Easy** by what actually happened. Your ratings decide when each card comes back, so generous ratings push weak cards away too soon.
- **See what you left out.** Blurt Mode has you write everything you remember about a file, then shows which key points you remembered, partly remembered or left out, and anything you wrote that the file disagrees with.
- **Track your weak spots.** Review's Progress page collects your weakest topics from file quizzes, and after a notebook quiz, **Review this next** suggests material that covers what you missed.

A quick start

1. Pick a topic you studied yesterday and feel good about.
2. Write five questions about it without looking at your notes.
3. Predict how many you'll get right, then answer them from memory.
4. Check every answer strictly and compare with your prediction.
5. Put the ones you missed on a list, and test yourself on them again in two days.

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The Memory Palace (Method of Loci): How to Build One

How the memory palace works, how to build one step by step, what it's good for (lists, sequences, names) and what it can't do: help you understand.

THE SHORT ANSWER

A memory palace links each item you want to remember to a place along a route you know well, then you walk the route in your mind to recall them. A meta-analysis of 13 trials found a medium-sized benefit for recall. It suits ordered lists and sequences, takes practice to use well, and doesn't build understanding.

Some things you just have to memorize: the order of the cranial nerves, the steps of a process, a list of causes, the twelve items on a checklist. Repeating them over and over is slow and the order tends to slip. The **memory palace**, also called the **method of loci** (Latin for "places"), is a technique for exactly this kind of material. You attach each item to a place along a route you already know, and recall them by walking the route in your head.

The bottom line: it works, with a medium-sized benefit in controlled trials, and people who train with it can get very good at it. But it is a tool for holding lists and sequences, not for understanding ideas, and it costs practice before it pays off. Use it for the handful of things that are pure memorization, and use recall and spaced review for everything else.

What a memory palace is

The method has three parts:

1. **A route you know well.** Your home, your walk to school, the inside of a building you use every day. What matters is that you can picture it easily and that it has a fixed order.
2. **Stations along the route.** Distinct places you pass in order: the front door, the coat hook, the kitchen table, the window. These are the "loci".
3. **Images placed at each station.** For each item you want to remember, you make a vivid picture that stands for it and imagine it sitting at the next station.

To recall, you walk the route in your mind and look at each station. The place cues the image, the image cues the item, and the route keeps everything in order.

The method has been in use for thousands of years and is used by many successful memory athletes (Twomey & Kroneisen, 2021). One brain-imaging study of people known for memory feats in contests such as the World Memory Championships found that their superior memory was not explained by unusual

intelligence or unusual brain structure. Instead, they used a spatial learning strategy, which engaged brain regions important for spatial memory, such as the hippocampus (Maguire et al., 2003). In other words, it is mostly a learned skill, not a gift.

What the research says

It reliably improves recall in trials. A 2021 meta-analysis pulled together 13 randomized controlled trials, most of them run with university students. People who used the method of loci recalled more than those in comparison conditions, with a medium effect size ($g = 0.65$). The effect held up when the authors adjusted for publication bias and removed studies one at a time (Twomey & Kroneisen, 2021).

The same review is candid about the limits. Most of the trials didn't report how they randomized participants or kept allocation hidden, so the risk of bias was rated high. And 13 trials is not a large evidence base. The authors call it "good initial support," which is a fair way to put it.

Training makes ordinary people much better at it. In a study published in *Neuron*, Dresler and colleagues (2017) first compared 23 memory athletes with matched controls. On a list of 72 words, the athletes recalled almost all of them 20 minutes later, while controls recalled about 40. Then 51 people with no mnemonic experience were split into three groups: six weeks of method-of-loci training (40 sessions of 30 minutes), training on a working-memory task, or no training. The loci group improved their word-list recall significantly more than both other groups, and the gain was still there at a four-month follow-up. Their brain connectivity also shifted toward the pattern seen in the athletes.

Two things are worth noticing. First, the training was substantial: about 20 hours over six weeks. Second, every participant in the training study was male, and the test was a list of unrelated words, which is the method's home ground.

Classroom evidence is thin. One study with medical students taught insulin and diabetes either through lectures plus a self-directed learning session, or through lectures plus a session in which students built memory palaces for the topic under a teacher's supervision and taught them to each other. The memory-palace group did better on the assessments, and the students found the method helpful (Qureshi et al., 2014). It's an encouraging result, but it is one topic at one school, and the memory-palace group also got a supervised, interactive session the other group didn't. So it can't tell you how much of the gain came from the palace itself.

Why it works

- **It borrows a memory you already have.** You don't have to learn the route; it's already well stored. You only add new links to it.
- **Places come with order built in.** You can't walk to the kitchen before the front door, so the route keeps the sequence for you.
- **Images are easier to hold than labels.** A strange picture at a familiar spot gives you more to grab onto than an abstract word.

- **It gives you a retrieval plan.** Instead of searching your memory at random, you walk station by station, and a gap shows up as an empty spot.

How to build one, step by step

1. **Pick a place you know very well.** Start with your own home. You should be able to walk through it in your head without effort.
2. **Fix a route.** Choose a direction and always walk it the same way, for example front door, hallway, living room, kitchen, bedroom.
3. **Choose 10 stations.** Pick distinct, well-separated spots along the route: the doormat, the mirror, the sofa, the TV, the fridge. Avoid two stations that look alike. Walk the route in your mind twice and list the stations from memory.
4. **Turn each item into an image.** Make it concrete and a bit absurd. For a list of causes of a war, a crown might stand for monarchy and a stack of coins for debt. For a term, use a picture of what it sounds like or what it means.
5. **Place one image at each station.** Make it interact with the place: the crown jammed in the doormat, coins pouring out of the mirror. Spend a few seconds on each.
6. **Walk it back.** Close your eyes, walk the route, and say each item. Note any empty stations and fix the image.
7. **Review it later.** Walk the route again the next day, then a few days after that. A palace you never revisit fades like anything else; see spaced repetition.

Once one route works, build a second and third (your school, a friend's house, a street). Reusing the same route for different lists on the same day can make them interfere, which is why the participants in the training study above built several routes.

What it's good for, and what it isn't

Good fit	Poor fit
Ordered lists: steps, stages, sequences	Understanding why a process works
Lists of items: causes, symptoms, criteria	Solving new problems in math or physics
Names and their order (rulers, elements, nerves)	Arguments, interpretations, essay planning
The structure of a speech or answer you've planned	Large bodies of facts that change often
A hook for a stubborn vocabulary word	Learning a language's vocabulary at scale

The research above mostly tests recall of lists, and that is where the method is strongest. Nothing in it shows that a memory palace helps you understand a concept or apply it to a problem you haven't seen. Knowing that the Krebs cycle has eight steps in a given order is useful. Knowing why each step happens is a different job, better served by explaining ideas in your own words and working through examples.

For vocabulary, a palace can work as a hook for a few words that won't stick, but it doesn't scale to thousands of words. The guide on how to learn vocabulary covers what does: recall in both directions, spaced over time, and words met in context.

Common mistakes

- **Using it for everything.** Building images takes time. Save it for material that is genuinely a list or a sequence.
- **A route you don't really know.** If you have to think about what comes next on the route, the route itself becomes something else to remember.
- **Bland images.** "A book on the table" is easy to forget. Make the image strange, specific and interacting with the place.
- **Stations too close together or too similar.** Two chairs side by side blur into one.
- **Building it once and never walking it again.** A palace is a memory like any other and needs spaced review.
- **Expecting results on day one.** The training study ran for six weeks. Early attempts are slow; they get faster.

Doing this in Atheneum

Write each palace as a note in the subject's notebook (Notes, in the notebook's rail), listing the stations in order and the image at each, so you can check yourself after a mental walk. Notes are Markdown, so a short table of station and image works well. Then turn the list into recall practice: make a flashcard deck for the notebook, or import your own cards from a text file through Anki import, and study them in Review, where each rating decides when a card comes back. See Notes in a notebook and Flashcards and spaced repetition.

If you're memorizing lists for an exam, the guide on how to use past papers shows how to find out which ones actually come up.

A quick start

1. Pick a list of 8 to 10 items you need to know in order for a class.
2. Choose 10 stations along a route through your home and walk them in your head twice.
3. Make one vivid image per item and place it at the next station.
4. Close your eyes and walk the route, saying each item. Fix any blank stations.
5. Walk it again tomorrow and again in three days, without looking at the list first.

Use the palace for what it's built for, keep testing yourself, and leave understanding to the methods that build it.

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GUIDE 29 · EXAMS · 9 MIN READ

How to Use Past Papers to Revise (Not Just Practice)

How to get the most from past exam papers: when to start, timed vs untimed, marking with the mark scheme, an error log, and turning mistakes into review.

THE SHORT ANSWER

Start past papers once you've covered most of the course, do early ones untimed and later ones timed, then mark strictly with the mark scheme. Log every lost mark with its cause and turn each into a flashcard or targeted re-study. Space papers out and use new papers rather than redoing old ones. Practice testing research backs this approach.

Almost every revision guide says "do past papers," and almost none say how. Many students sit a paper, look at the score and move on, which uses a fraction of its value. A past paper is a practice test written in the exact format you'll face, and the marks you lose on it are the most precise list you'll ever get of what to study next.

The bottom line: practice testing is one of the best-supported revision methods there is, and past papers are the most exam-like form of it. Research on past papers *specifically* is scarce, so the advice below comes from the wider research on practice testing and feedback, applied to papers. The gains come less from sitting the paper than from what you do after it.

What the research says (and what it doesn't)

Practice testing beats restudying. A meta-analysis by Adesope, Trevisan and Sundararajan (2017) compared practice tests with non-testing conditions such as restudying. Practice tests were more beneficial for learning than restudying and every other comparison condition, though the size of the benefit depended on the type of test, the learners and how outcomes were measured. A large review of ten study techniques rated practice testing as one of the two most useful, alongside spacing study out over time (Dunlosky et al., 2013).

It works in real classrooms, not just labs. A 2021 meta-analysis of 222 classroom studies, with data from more than 48,000 students, found that quizzing raised academic achievement by a medium amount ($g = 0.499$). The effect was larger or smaller depending on several factors, including whether practice and final tests used a consistent format, whether the material matched, whether students got corrective feedback, and how many times they were tested (Yang et al., 2021).

Practicing in the exam's format matters. A classic study by Morris, Bransford and Franks (1977) found that how well people remembered words depended on whether the kind of processing they did while learning matched what the test required. Words studied for their meaning were better recognized on a standard test, but words studied for their sound were better recognized on a test about rhymes. This idea,

transfer-appropriate processing, is one of the explanations the 2021 classroom review found support for. Past papers are the purest version of it: you practice the same kinds of question, in the same format, under the same conditions.

The benefit can reach new questions, with limits. Exam questions won't be the ones you practiced, so it matters whether testing helps with different questions. In four experiments, Butler (2010) found that repeated testing led to better performance than repeated studying a week later, including on new inference questions and questions from a different domain. A meta-analysis of transfer found that testing does produce learning that carries over to new questions on average (d = 0.40), most clearly across test formats and to application and inference questions. But after correcting for publication bias, the authors found that transfer often shrank to nothing when none of the conditions that helped it were present: doing well on the practice test, retrieval that required elaborating on the answer, and responses that matched between practice and final test (Pan & Rickard, 2018). In plain terms: don't expect a paper to teach you to answer questions on topics you've only memorized, and make sure you get feedback on what you got wrong.

What's missing. We couldn't find solid controlled studies that test "doing past papers" as a revision method on its own, or that compare timed with untimed papers. So the specific routine below is a reasonable application of the research, not something directly proven.

When to start

Start once you've covered most of the course, not in the last week. A paper mixes every topic, so if half are new to you, it mostly shows what you haven't learned yet. Before that, use past-paper questions one topic at a time.

A rough plan for a final exam:

- **6 to 8 weeks out:** topic-by-topic questions from past papers as you finish each topic.
- **3 to 6 weeks out:** first full papers, untimed, with notes closed.
- **Last 2 to 3 weeks:** full papers under timed exam conditions, one every few days.

Fit this into an exam revision timetable so papers have their own sessions, and leave time after each one for marking and fixing.

Timed or untimed?

Both, at different stages.

- **Untimed** papers show what you know when time isn't the problem. Do these first. Still keep notes closed: looking things up turns a test into rereading.
- **Timed** papers show whether you can finish under exam conditions, and expose pacing problems before the day. Use the real time limit, no phone and no notes.

Marks lost only when timed point to speed or nerves, not knowledge; the guide on exam anxiety covers the nerves.

Marking with the mark scheme

Mark every paper yourself, strictly, against the official mark scheme.

1. **Mark the same day,** while you remember your reasoning.
2. **Be harsh.** If the scheme wants a specific term and you wrote something close, it's not the mark.
3. **Read the scheme for what earns marks,** not just whether you were right. They show which words examiners look for and how many points a long answer needs.
4. **Read the examiners' report,** if your exam board publishes one. It lists common mistakes across all candidates.

Corrective feedback is one of the factors that strengthened the classroom testing effect (Yang et al., 2021). Marking is your feedback, so don't skip it.

Keep an error log

Every lost mark goes in a log. One line each:

Paper and question	Topic	What I did	Why I lost the mark	Fix
2023 P1 Q4	Enzymes	Said heat "kills" enzymes	Needed "denatures, active site changes shape"	Flashcard + reread notes on denaturation
2022 P2 Q7	Algebra	Dropped a minus sign	Careless, under time pressure	Check signs at the end of every line

Sort the causes into a few types: **didn't know it**, **knew it but couldn't recall it**, **misread the question**, **wrong exam technique** (missed the command word, not enough points), and **ran out of time**. After three or four papers, the patterns tell you what to revise much more precisely than a score does.

Mistakes are useful here, not shameful. A review of research on learning from errors found that making errors and then getting corrective feedback helps learning, especially for errors made with high confidence, and that analyzing the reasoning behind a mistake matters (Metcalfe, 2017).

Turn mistakes into review

The log is only useful if it changes what you do next.

- **Knowledge gaps:** re-study that section, then test yourself on it. Make a flashcard for any fact or definition you lost marks on, with the mark scheme's wording on the back. See active recall vs rereading for why testing beats rereading the section.
- **Recall failures:** add the item to your flashcards and review it on a schedule, not once.

- **Technique errors:** write a one-line rule ("'Evaluate' means give both sides and a judgment") and check it before the next paper.
- **Timing:** practice the slow question type under a timer on its own.

Space papers out, and don't just redo the same one

Three papers in one weekend leaves no time to fix what the first one revealed. Space them out, with a few days of targeted work between them. Spacing is the other technique the Dunlosky review rated most useful, and a review of 317 experiments on spaced study found that the best gap between sessions grows the longer you need to remember the material (Cepeda et al., 2006).

Use a new paper each time where you can. Redoing a paper you've marked mostly tests whether you remember those answers. If you run out, redo only the questions you got wrong, weeks later, without your old answers, or use questions from other boards on the same syllabus.

Common mistakes

- **Doing papers with notes open.** That's rereading with extra steps.
- **Only looking at the score.** The score tells you how you did; the error log tells you what to do.
- **Starting too late,** so there's no time to act on what the papers show.
- **Using up every paper early,** leaving none for timed practice.
- **Memorizing mark-scheme answers** instead of understanding them.

Doing this in Atheneum

- **Keep papers with the subject.** Upload past papers and mark schemes (PDF or Word) to the subject's notebook, and keep your error log as a note there. See Uploading files to a notebook and Notes in a notebook.
- **Time the paper.** The Pomodoro timer lets you set the focus length from 1 to 180 minutes, so you can set it to the exam's time limit.
- **Turn the log into cards.** Make a tab-separated text file of front and back from your error log and bring it in through Anki import, then study it in Review on a spaced schedule. See Anki import and export.
- **Plan the papers.** Put the exam and each paper session in the calendar, so they're spaced out. See Calendar.

If a mistake is a list or sequence you keep forgetting, a memory palace can help hold it.

A quick start

1. Find the past papers and mark schemes for your exam and check how many there are.
2. Pick one you haven't seen and do it untimed, with notes closed.
3. Mark it strictly against the mark scheme the same day.
4. Write every lost mark in an error log with its cause and a fix.

5. Make flashcards for the knowledge gaps and spend the next two sessions on them.
6. Book your next paper for a few days later, and make it timed.

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Online: atheneum.app/guides/how-to-use-past-papers · Updated 2026-10-23

GUIDE 30 · FOCUS · 9 MIN READ

Taking Breaks While Studying: How Often and What to Do

What research says about study breaks: how long to work before stopping, what kind of break helps, and why scrolling your phone is a poor rest.

THE SHORT ANSWER

Take short, planned breaks rather than pushing on until you're exhausted. Micro-breaks reliably reduce fatigue, though their effect on performance is small. Rest quietly or move, and leave your phone alone: in lab studies, phone and social media breaks restored less. No block length is proven best; 25 minutes on, 5 off is just a convention.

Most students treat breaks as lost time: something you allow yourself once you've earned it, or something that happens by accident when your attention wanders to your phone. Neither works very well. Breaks you plan tend to be shorter and more useful than breaks you drift into, and what you do during a break matters almost as much as when you take it.

The short version: work in blocks you decide on in advance, take a few minutes off between them, and spend those minutes resting, moving or looking at something other than a screen. The research behind this is real but more modest than the advice you'll often read online, so this guide is careful to say where it stops.

What the research says about short breaks

The best overview is a 2022 meta-analysis of "micro-breaks", meaning breaks of up to about ten minutes taken between tasks (Albulescu et al., 2022). It pooled 22 study samples with more than 2,300 participants. Short breaks had a small but reliable effect on how people felt: they boosted vigor and reduced fatigue. Their effect on overall performance was smaller and not statistically significant. When the authors split tasks by type, breaks helped performance only on less demanding tasks. Longer breaks gave a bigger boost to performance, and the authors suggest that recovering from a really draining task may take more than ten minutes.

That is a useful, honest picture. Breaks make long sessions feel more bearable and keep fatigue down. They are not a trick that makes hard work easier on their own, and a two-minute pause won't refresh you after three hours of exam questions.

A second line of research looks at why attention fades on long, repetitive tasks. In a lab vigilance task, people's performance declined steadily over time, but when they were made to switch briefly to another small task now and then, the decline disappeared (Ariga & Lleras, 2011). The authors argue that attention

fades partly because the brain stops treating an unchanging goal as important, and that brief switches away and back reset it. This was one lab task, not a study of revision, but it fits the everyday experience of reading the same page three times.

Planned breaks or "when I feel like it"?

A 2023 study compared these directly with 87 university students during a real day of self-study (Biwer et al., 2023). One group took breaks whenever they chose. Two groups took fixed breaks: 6 minutes after every 24 minutes of study (close to the Pomodoro Technique), or 3 minutes after every 12 minutes.

The students who chose their own breaks studied in longer stretches and took longer breaks. They also reported more fatigue and distraction and less concentration and motivation than the fixed-break groups. All three groups got through about the same amount of work, so the fixed-break groups did it in less total time. It was a single day with self-reported mood, but it tested real studying, not a lab task.

Rest after learning helps memory

Breaks may also help you keep what you just studied. In a 2012 study, people listened to two short stories. After one, they rested quietly with their eyes closed for 10 minutes; after the other, they played a spot-the-difference game for 10 minutes (Dewar et al., 2012). They remembered more of the story followed by rest, both 15 to 30 minutes later and a week later. The authors propose that a quiet pause right after learning lets new memories settle before anything else competes for attention.

These are lab studies with short stories and word lists, not courses, so treat them as a reason to pause briefly after an important block of learning, not as proof that resting will raise your grades. Sleep does a larger share of this work; see the guide to sleep and studying.

Why your phone isn't much of a break

Reaching for your phone is the default break for most people, and two experiments suggest it restores less than it seems to.

- In a study of 414 people solving anagrams, some took a mid-task break doing the same simple activity on a phone, on a computer or on paper, and some took no break. Those who took their break on a phone did worse in the second half than those who used a computer or paper, both in speed and in anagrams solved (Kang & Kurtzberg, 2019).
- In another, people learned a vocabulary list and then either rested for 8 minutes or used social media for 8 minutes. The social media group remembered fewer words afterward, both later that session and a day later (Martini et al., 2020).

Both are single lab studies, and neither shows that one glance at your phone ruins a study session. But together they suggest that a phone break isn't the neutral rest it feels like, especially straight after learning something new. If phones are a regular problem for you, see phones and studying.

Moving during a break

Getting up and moving is a sensible use of a break, and the evidence on why is mixed. A meta-analysis of 79 studies of single bouts of exercise found a positive but small effect on cognitive performance overall, with larger effects for some kinds of tasks and some types of exercise (Chang et al., 2012). A review of classroom movement breaks for children found they increased physical activity and time on task, but there was not enough repeated research to show benefits for cognition or academic performance (Daly-Smith et al., 2018).

So a walk or a stretch is a good break mainly because it is a real change from sitting and staring at notes, not because it will make you noticeably smarter for the next block.

How long should a study block be?

There is no single proven number. The 25 minutes on, 5 off used by the Pomodoro Technique is a convention. It's a good starting point because it's short enough to begin when you don't feel like studying, and the study above found fixed 24/6 and 12/3 schedules both worked better for mood than no schedule. But nothing shows that 25 beats 40 or 50.

A practical way to choose:

- **Start with 25 and 5.** If you regularly lose focus before the timer, shorten the block. If you're often in the middle of something good when it rings, lengthen it.
- **Match the block to the task.** Flashcards and practice questions break naturally into short blocks. Writing an essay or working a long problem may need 45 to 50 minutes to get anywhere.
- **Take a longer break every few blocks.** The micro-break evidence suggests short pauses don't fully cover demanding work. After about two hours, take 15 to 30 minutes properly away.
- **Decide before you start.** The planned-break groups in Biwer et al. (2023) felt better than the ones who decided as they went.

Once you've found a rhythm that works, keep it the same from day to day. A fixed block length at a fixed time is easier to start than a fresh decision every session; the guide to building a study habit covers how to make that routine stick.

What to do in a break

Good breaks:

- **Stand up and move.** Walk to another room, stretch, get some water.
- **Rest your eyes and mind.** Look out of a window, or sit quietly with your eyes closed for a few minutes, especially after learning something new.

Breaks that tend to backfire:

- **Your phone, especially social media.** It's hard to stop after five minutes, and the studies above suggest it restores less.
- **Starting something with no natural end.** An episode, a game or a conversation thread rarely stays at five minutes.
- **Studying something else.** Switching subjects is a change of task, not a rest.

Common mistakes

- **Skipping breaks to "make up time".** Fatigue builds, and the session gets longer and less focused.
- **Breaks with no end time.** Set the timer for the break as well as the work.
- **Judging a block length after one session.** Try a schedule for a week before changing it.
- **Treating the timer as a strict rule.** If you're in the middle of a hard problem, finishing it is fine. The point of the schedule is to make breaks happen, not to interrupt real progress.

Doing this in Atheneum

The Pomodoro timer runs 25-minute focus rounds with 5-minute short breaks and a 15-minute long break after every fourth round. You can change the focus length to anything from 1 to 180 minutes; break lengths are fixed. The timer keeps running on other pages, shows the time left in the top bar, and can play a sound or send a browser notification when a round ends, so you don't have to watch the clock. The Pomodoro page also has **Breathing**, a calming exercise you can use as a short screen-light break; see Breathing and panic mode.

A quick start

1. Pick one task and set a 25-minute focus block.
2. Before you start, decide what you'll do in the break: a walk to the kitchen, a stretch, or a few minutes looking out of the window.
3. When the timer ends, stop, and leave your phone where it is.
4. After four blocks, take a longer break of 15 to 30 minutes away from your desk.
5. At the end of the week, adjust the block length to what actually kept you focused.

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Online: atheneum.app/guides/taking-breaks-while-studying · Updated 2026-10-23

GUIDE 31 · FOCUS · 8 MIN READ

How to Build a Study Habit That Sticks

How study habits form: if-then plans, fixed times and places, starting small, tracking, how long it really takes, and what to do after a missed day.

THE SHORT ANSWER

Tie a small study action to a cue you meet daily, like "after dinner at my desk, I'll do 20 flashcards", and repeat it in the same place. If-then plans reliably help people follow through. Habits took anywhere from 18 to 254 days to form in one study, and missing a single day did not materially set people back.

Most students study in bursts. A good week, then a busy one, then a panic before the exam. Every restart takes willpower, and willpower is exactly what runs out when you're tired or behind. A habit is the opposite: studying becomes the thing you do at a certain time and place without having to talk yourself into it.

You can't decide to have a habit, but you can set up the conditions that build one. The research points to a few things that matter: a clear plan for when and where, the same cue every day, an action small enough to repeat, and patience, because it takes longer than the "21 days" you may have heard. This guide covers each one, with honest notes on what the studies did and didn't test.

What a habit actually is

In psychology, a habit is an action that's triggered automatically by a context you've repeatedly done it in. A review by Wood and Neal (2007) describes habits as learned links between a behavior and features of the situation around it, such as the place, the time or the thing you just did. Once the link is strong, the situation starts the behavior without you needing to think about your goal first.

That has a practical consequence: a habit lives in its cue. A study of students who transferred to a new university found that their exercise, newspaper-reading and TV habits survived the move only when key parts of the context stayed the same (Wood et al., 2005). Change the context and the habit loses its trigger.

For studying, the argument is that good routines can make useful behaviors like studying and sleeping the default, so they need less willpower, and that what looks like a lack of motivation is often a context that keeps cueing something else (Fiorella, 2020). That's a review of theory, not an experiment, but it changes the question from "how do I want it more?" to "what is my environment cueing me to do?"

Plan the when and where: implementation intentions

The best-tested tool here is the **implementation intention**: an if-then plan that names the situation and the action. "I'll study more" is a goal. "If it's 4pm on a weekday and I'm at the library, then I'll do 20 flashcards" is an implementation intention.

A meta-analysis of 94 independent tests found that forming if-then plans had a medium-to-large effect on reaching goals, compared with only intending to (Gollwitzer & Sheeran, 2006). The authors report that these plans helped people get started, protect their effort from distractions, and let go of approaches that weren't working, and that making the plan made the chosen cue easier to notice and the response more automatic. The studies covered many kinds of goals, not specifically studying, so take it as strong general evidence rather than a promise about exam results.

Writing a good plan:

- **Name a cue you'll definitely meet.** A time, a place, or the end of something you already do daily: "after my last class", "when I sit down at my desk after dinner".
- **Name one concrete action.** "Do 20 flashcards" or "write out one past-paper answer", not "revise biology".
- **Write it down.** Use the exact if-then form.
- **Plan for the obstacle too.** "If my friends ask me to go out at 4, then I'll do the flashcards on the bus first."

How long it takes (longer than 21 days)

The best-known study of real-world habit formation followed 96 volunteers who each picked a daily eating, drinking or exercise behavior to do in the same context, such as "after breakfast", for 12 weeks (Lally et al., 2010). They rated how automatic it felt every day.

- Automaticity rose quickly at first, then leveled off.
- The time to reach close to each person's plateau ranged from **18 to 254 days**. In a short summary for doctors, the same research group gave the average as about 66 days, with considerable variation between people and behaviors (Gardner et al., 2012).
- People who did the behavior more consistently fit the habit-forming pattern better.

A 2024 meta-analysis of 20 studies of health habits found a similar picture: median times of about two months, means of 106 to 154 days, and a range from 4 to 335 days between individuals (Singh et al., 2024). The authors note that most of the included studies had a high risk of bias.

None of these studies looked at studying. Studying is also more effortful than drinking a glass of water, and Gardner et al. (2012) note that simpler actions become habitual more quickly. So expect weeks to months, not days, and expect it to vary.

Start small

Because simple actions turn into habits faster, the starting action should be smaller than feels worthwhile. Gardner et al. (2012) advise aiming for small, manageable changes, partly because failing at a big one is discouraging.

For studying, that might mean:

- 10 flashcards after dinner, not "an hour of revision".
- Opening tomorrow's lecture notes and reading the headings.
- One past-paper question before bed.

Once the action happens without a fight, add to it. A small daily routine that survives a bad week is worth more than an ambitious one that only happens in good weeks. Starting small is also one of the most practical ways to stop procrastinating.

Keep the context stable

Since a habit is cued by its context, the more of the context you keep the same, the better:

- **Same time.** Ideally anchored to something that already happens daily, like a meal or the end of classes.
- **Same place.** A particular desk, library floor or table. If you can, keep that spot for studying only.
- **Same start.** The same first action each time: open the same notebook, start the same timer.
- **Remove competing cues.** If your phone on the desk cues scrolling, the habit you're building has a rival. Put it in another room.

When your context changes, such as a new term, a holiday or a different timetable, expect the habit to wobble, and write a new if-then plan for the new situation instead of waiting for it to return on its own.

Track it

Recording what you do helps. A meta-analysis of 138 experiments found that interventions that got people to monitor their progress increased goal attainment, and the effect was larger when progress was physically recorded or shared with others (Harkin et al., 2016).

Keep tracking simple: a mark on a calendar, a tick in a notebook, a streak counter. Track whether you did the small action, not how many hours you studied, so a short day still counts.

What to do after you miss a day

You will miss days. Lally et al. (2010) found that missing one opportunity to perform the behavior did not materially affect the habit formation process; Gardner et al. (2012) add that automaticity gains soon resumed after a single miss.

That's the most useful finding for anyone who has abandoned a routine after one bad day. A missed day isn't a reset to zero. What the research doesn't tell you is how many misses are too many; it found that consistency mattered, so the practical rule is simply to get back to it the next day. Missing two in a row is the point to check whether the plan still fits your week.

Common mistakes

- **Starting with a huge commitment.** Two hours a day sounds good on Sunday night and collapses by Wednesday.
- **No fixed cue.** "Sometime this evening" is not a cue. Pick a time, a place or an existing routine.
- **Expecting it to feel automatic in three weeks.** It may take months; that's normal.
- **Quitting after a miss.** One missed day barely matters. Abandoning the routine does.
- **Relying on motivation.** The whole point of a habit is that it runs on cues, not on how you feel that day.

Doing this in Atheneum

- Put your study block on the Calendar at the same time each day, with a reminder. Reminders only fire while the Calendar page is open and notifications are allowed.
- Set a daily goal in Review of 10, 20, 30 or 50 items; a seven-day strip shows which days you reached it, and Review counts its own review streak.
- Your main streak is weekly: a week counts once you study on any day in it, such as finishing a Pomodoro round or completing a task, so a missed day never breaks it (see Badges, streaks and points).
- Start each session the same way with the Pomodoro timer. For how long to make each block and what to do between them, see taking breaks while studying.

A quick start

1. Choose one small study action you could do even on a bad day.
2. Write an if-then plan for it: "If it's [time] and I'm at [place], then I'll [action]."
3. Put it in your calendar at that time for the next two weeks.
4. Mark each day you do it.
5. If you miss a day, do it the next day without making up for it.
6. Once it feels easy, make the action a little bigger, and fit it into your exam revision timetable.

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GUIDE 32 · EXAMS · 9 MIN READ

How to Study for Finals in a Week (Honestly)

A 7-day plan for finals: what a week can and can't do, how to triage topics, why practice tests beat rereading, and why sleep stays in the plan.

THE SHORT ANSWER

A week is enough to make real progress but not to learn a whole course well, so triage. Test yourself to find weak topics, spend most of your time on the ones the exam weights most, and study with practice questions rather than rereading. Spread each topic across several days instead of one block, and keep sleeping normally.

You have a week. Maybe the semester got away from you, maybe you had three other exams first, maybe you just put it off. Either way, the question isn't whether you should have started earlier. It's what to do with the seven days you have.

The bottom line: a week of focused work can make a real difference, but it can't do what a month would. So don't try to cover everything equally. Find out what you don't know, put your time where the marks are, test yourself instead of rereading, revisit each topic on more than one day, and keep sleeping. The rest of this guide explains why, and ends with a day-by-day plan.

What the research says (and what it doesn't)

Cramming works for the short term, which is why it feels like it works. When study is crammed into one session, performance right after it can look just as good as when the same study is spread out. The difference shows up later. In a classroom study, high school students learned French vocabulary either in one 30-minute block or in three 10-minute sessions on three days. On a test right after studying, the two groups did about the same; on a test four days later, the spread-out group did substantially better (Bloom & Shuell, 1981). With longer texts, Rawson and Kintsch (2005) found the same pattern for rereading: reading a text twice in a row helped on an immediate test, while rereading it a week later helped on a test two days after that.

Students can't feel the difference. In a set of flashcard experiments, spacing study out was more effective than massing it, and also more effective than cramming on the last day before the test. Spacing beat massing for 90% of the participants. Yet after the first study session, 72% of them believed massing had worked better (Kornell, 2009). What feels productive and what lasts are not the same.

Even within a week, spacing helps. A large study of more than 1,350 people looked at how long to wait between a first study session and a review. The best gap depended on how far away the test was: for a test one week later, it was about 20 to 40% of that week, roughly a day or two (Cepeda et al., 2008). So a week

is short, but it's long enough to see each topic two or three times instead of once. A review of 317 experiments found the same general rule: the further away the test, the longer the best gap between sessions (Cepeda et al., 2006).

Testing yourself beats rereading, especially after a delay. Roediger and Karpicke (2006) had students either reread a passage or take recall tests on it. On a test five minutes later, rereading came out ahead. Two days and a week later, the students who had tested themselves remembered substantially more, even though the rereaders felt more confident. A meta-analysis found practice tests more beneficial for learning than restudying and every other comparison condition (Adesope et al., 2017), and a review of ten study techniques rated practice testing and spacing as the two most useful (Dunlosky et al., 2013).

What's missing. We couldn't find controlled studies of "the last week before finals" as such, or of how to split a week between several exams. The plan below applies the research above to that situation; it isn't a tested recipe.

Step 1: triage before you study

The biggest mistake with a week left is starting at chapter one and working forward. You'll run out of days with the hardest material untouched.

Spend the first session finding out where you stand:

1. **List every topic** the exam covers, from the syllabus, the lecture list or the review sheet.
2. **Note the weight of each one.** Which topics appear most in past papers? Which did the instructor spend most time on, or say will be on the exam?
3. **Test yourself on each topic for a few minutes,** notes closed. Do a couple of practice questions or a quick blurt. Then mark it red (can't do it), amber (partly) or green (could answer a question now).

Rating topics by feel is unreliable; the guide on judging what you know explains why. A few minutes of testing gives you a far more honest color.

Now sort. **High-weight red and amber topics come first.** Low-weight red topics may need to be dropped or reduced to the basics. Green topics get only short reviews. Knowing 80% of the exam well beats skimming 100% of it.

Step 2: study by testing, not rereading

With a week, you can't afford sessions that feel productive but don't last. For each topic:

- **Read or watch just enough to fill a gap,** then close it.
- **Test yourself straight away:** past-paper questions, end-of-chapter problems, flashcards or a blurt.
- **Check against the answer, and fix what you missed.** A practice question without checking is only half the work.

Turn anything you keep getting wrong into a flashcard so it comes back on later days. For the reasoning behind this, see active recall vs rereading; for how to get the most from papers in the time you have, see how to use past papers.

Step 3: see every topic more than once

Instead of "Monday is chapter 3, Tuesday is chapter 4," put each important topic on two or three different days. A first session, a short review a day or two later, and a final check near the end. Mixing a few topics within a session also helps for exams that mix questions; the interleaving guide covers why.

Step 4: keep sleep in the plan

Cutting sleep is the obvious way to find more hours, and it tends to backfire. In a two-week diary study of 535 high school students, on days when students gave up sleep to study more than usual, they had more trouble understanding material in class and were more likely to struggle on a test or assignment the next day (Gillen-O'Neel et al., 2013). The guides on sleep and studying and all-nighters go into the details.

A 7-day plan

Adjust the days to your timetable. The shape matters more than the exact hours. If you have more than one exam, give each day's main block to the nearest exam and use shorter blocks for the others.

Day	Main work	Finish line
1	Triage: list topics, check weights, test yourself on each, rate red/amber/green	Every topic has a color and a priority
2	First pass on the top two or three high-weight red topics: fill gaps, then practice questions	Flashcards made for what you missed
3	Next red and amber topics; short review of Day 2's topics	Day 2 topics re-tested
4	Remaining amber topics; first timed practice paper or a long set of mixed questions	Paper marked, mistakes logged
5	Fix what Day 4 showed; review Days 2–3 topics again	Each priority topic seen at least twice
6	Second timed paper or mixed set; short reviews of everything green	Final list of weak spots
7 (day before)	Light review: flashcards, a quick blurt of each key topic, nothing new	Done by early evening, normal bedtime

Within each day, work in focused blocks with breaks; the Pomodoro technique is a good fit. If the exam is multiple choice, the guide on studying for multiple-choice exams has format-specific advice.

Common mistakes

- **Rereading the whole textbook.** It feels like progress and fades fast. Test instead.
- **Treating every topic as equal.** Put time where the marks are.
- **One topic per day, never revisited.** Each topic should come back at least once.
- **Making beautiful notes.** With a week left, there isn't time to rewrite; practice instead.
- **Trading sleep for hours.** The extra hours come back as a worse next day.
- **Learning new material the night before.** Day 7 is for review, not new chapters.

Doing this in Atheneum

- **Put the exam on the calendar.** Add it with the type **Exam** and the calendar shows how many days are left. Add your study sessions as events too. See Calendar.
- **Upload the course material.** Add lecture slides, notes and past papers (PDF or Word) to the subject's notebook. See Uploading files to a notebook.
- **Triage with Blurt Mode.** Pick a file in Blurt Mode, write what you remember with it hidden, and Athena shows which key points you covered, partly covered and left out. That's a quick red/amber/green check.
- **Practice with quizzes.** Generate a quiz from the notebook and take it one question at a time; the results show the correct answer for anything you missed and suggest what to review next. See Quizzes.
- **Bring cards back on later days.** Make a flashcard deck from the notebook and study what's due each day; your ratings decide when each card returns. See Flashcards and spaced repetition.
- **Time your blocks.** The Pomodoro timer runs focus rounds and breaks.

Generating quizzes, decks and blurt checks uses AI credits.

A quick start

1. Write down your exam date and the hours you really have on each of the next seven days.
2. List every topic and note how much weight it carries on the exam.
3. Spend 30 to 60 minutes testing yourself on each topic and rate it red, amber or green.
4. Plan Days 2 to 6 so high-weight red and amber topics come first and each one appears on at least two days.
5. Start your first topic today with practice questions, not rereading.
6. Set a bedtime for the week and keep it.

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GUIDE 33 · EXAMS · 8 MIN READ

Should You Pull an All-Nighter Before an Exam?

What research says about all-nighters before exams: how a night without sleep affects attention and memory, why it feels fine, and what to do instead.

THE SHORT ANSWER

Usually not. A night without sleep hurts attention most, and in one study sleep-deprived students did worse on a thinking test while rating their own performance higher. Sleep after studying also helps new material stick. If time is short, study in the evening, go to bed, and do a short review in the morning.

It's late, the exam is tomorrow, and there's more left to cover than there are hours before morning. Staying up all night can look like the only option, and a lot of students take it. In a survey of 120 students at a liberal arts college, 60% said they had gone a whole night without sleep at least once since starting college, and those who had tended to have lower grades (Thacher, 2008). That's a correlation, so it can't show the all-nighters caused the lower grades, but it's a start.

The bottom line: for most exams, an all-nighter trades a few extra hours of study for a worse brain on the day. A night without sleep hits attention hardest, it makes it harder to remember what you studied, and you're unlikely to notice how much it's costing you. If you're short on time, a shorter study session followed by sleep is usually the better bet.

What the research says (and what it doesn't)

Attention takes the biggest hit. A meta-analysis of 70 articles on short-term total sleep deprivation (under 48 hours) looked at six kinds of thinking. The effects ranged from small and not significant for reasoning accuracy to large for lapses in simple attention, the moments where you just miss something (Lim & Dinges, 2010). On an exam, that looks like misreading a question, skipping a part of it or making a slip in a calculation you know how to do.

You won't feel how impaired you are. Pilcher and Walters (1997) had 44 college students take a critical-thinking test after either 24 hours without sleep or a normal night. The sleep-deprived students did significantly worse, but rated their concentration and effort higher, and estimated their own performance higher, than the students who had slept. The authors concluded that students aren't aware of how much sleep deprivation affects them. Feeling fine at 4 a.m. is not good evidence that you are.

Sleep after studying helps it stick. A review by Diekelmann and Born (2010) describes sleep as a state that favors the consolidation of newly learned material: memories formed during the day are reactivated and stabilized. In two experiments with high school students learning vocabulary, Gais, Lucas and Born

(2006) found that memory was better when sleep followed within a few hours of learning, and that sleep deprivation still hurt memory after a night of recovery sleep. Staying up all night means the material you crammed never gets that night.

And sleep before learning matters too. In a brain-imaging study, Yoo and colleagues (2007) found that one night without sleep weakened activity in the hippocampus, a region central to forming new memories, while people were learning, and they remembered less afterwards. So anything you try to learn the morning after an all-nighter is taken in by a brain that's worse at storing it.

It shows up the next day. In a daily-diary study of 535 high school students, on days when students gave up sleep to study more than usual, they had more trouble understanding what was taught in class and were more likely to struggle on a test or assignment the next day (Gillen-O'Neel et al., 2013).

Being awake that long is like being drunk, on some tests. Williamson and Feyer (2000) compared sleep loss with alcohol in 39 people from the transport industry and the army. After 17 to 19 hours awake, performance on some tests was as bad as or worse than at a blood alcohol level of 0.05%, and after longer without sleep it reached the level of the highest dose they gave (0.1%). These weren't students taking exams, but it's a good reason not to drive to the exam after a night without sleep.

What we don't know. We couldn't find a controlled study that compared an all-nighter with a normal night on a real exam, or that tested how much sleep is "enough" the night before. One study of 88 college chemistry students who wore sleep trackers for a semester found that sleep over the week and month before a test went with better grades, while sleep on the single night before was not related to that test's score (Okano et al., 2019). It's a correlation in one class and doesn't separate all-nighters from slightly short nights, so it can't tell you a night without sleep is harmless. What it does suggest is that sleep across the term matters more than any one night.

What to do the night before instead

Decide what matters most. You can't cover everything tonight, and trying to is what leads to staying up. Pick the few topics most likely to be on the exam and that you're weakest on.

Test yourself, don't reread. Use the hours you have on practice questions, flashcards or a quick blurt of each key topic. Testing yourself does more for a delayed test than rereading; see active recall vs rereading.

Set a stop time and keep it. Decide now when you'll stop, leaving enough time for a real night's sleep before your alarm. Studying until you're done is how a late night becomes an all-nighter.

Do a short review in the morning. Go over the same key points briefly after you wake up: a few flashcards or a quick blurt, not new material. In one study, 40 people learned foreign vocabulary in two sessions 12 hours apart; those who slept between the sessions needed about half as much practice to relearn the words, and remembered them better a week and six months later (Mazza et al., 2016). The guide on sleep and studying has more on this.

Wind down. Finish studying a little before bed. If nerves are keeping you awake, the guide on exam anxiety has a few ideas worth trying.

If you've already lost the night

Sometimes it happens anyway. If you've had little or no sleep:

- **Don't drive** if you can avoid it. Get a lift, take the bus or walk.
- **Keep the morning simple.** Light review of what you already know, not new material.
- **Slow down in the exam.** Attention lapses are the main risk, so read every question twice, underline what it asks and check your answers before handing in.
- **A nap may help afterwards.** A meta-analysis of 54 studies found that afternoon naps had a small to medium benefit on several kinds of test, including memory and vigilance (Leong et al., 2022). It doesn't replace a night, but if you have time before a second exam, it may be worth taking.
- **Get back to a normal night** as soon as you can, especially if you have more exams coming.

Why it keeps happening, and how to stop it

All-nighters usually come from a plan that ran out of room, or from no plan. The fix is upstream: start revising a few weeks out with an exam revision timetable, and if it's already the last week, use the one-week plan for finals, which keeps sleep in. If putting off the work is the real problem, see the guide on procrastination.

Doing this in Atheneum

Atheneum doesn't track your sleep. It can help you study efficiently in the hours before bed, and plan so there's no last-night scramble.

- **Test yourself in the evening.** Take a quiz from the notebook in Review, or blurt a file in Blurt Mode and let Athena show what you left out. See Quizzes.
- **Review in the morning.** Study the flashcards that are due; your ratings decide when each card comes back. See Flashcards and spaced repetition.
- **Stop on time.** Decide how many focus rounds you'll do tonight on the Pomodoro timer, and stop when they're done.
- **Calm down before bed or before the exam.** The Pomodoro page has a guided breathing exercise and a panic mode. See Breathing and panic mode.
- **Plan the next exam earlier.** Put exams in the calendar as type **Exam** to see the countdown, and add study sessions well before. See Calendar.

A quick start

1. Write down the three to five topics most likely to be on tomorrow's exam that you're least sure of.
2. Set a stop time tonight that leaves a full night's sleep before your alarm.
3. Until then, test yourself on those topics with questions, flashcards or a blurt.

4. Go to bed at the stop time, even if you haven't covered everything.
5. In the morning, do a short review of the same topics, then leave on time.

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GUIDE 34 · EXAMS · 9 MIN READ

How to Study for Multiple-Choice Exams

How to study for multiple-choice exams: why recognizing an answer isn't knowing it, recall first, why feedback matters, and when to change answers.

THE SHORT ANSWER

Practice recalling answers before you look at options, since recall practice tends to help more than recognition, then use multiple-choice questions with feedback, because wrong options you pick can stick without it. Think about why each wrong option is wrong. In the exam, changing an answer when you have a good reason more often helps than hurts.

Multiple-choice exams look easier than essays because the answer is right there on the page. That's exactly what makes them tricky to study for. Seeing the right answer and thinking "yes, that one" feels like knowing it, but it's a weaker kind of memory than being able to produce the answer yourself, and the exam's wrong options are written to catch people who only half know.

The bottom line: study as if the exam were short-answer, then practice in the multiple-choice format with feedback. Recall first, recognize second. When you practice with multiple-choice questions, check every answer and work out why each wrong option is wrong. And in the exam itself, don't be afraid to change an answer when you have a real reason to.

Recognition isn't recall

There are two ways to "know" something. **Recall** is producing it from memory with nothing to prompt you: what's the function of the mitochondria? **Recognition** is picking it out when you see it: which of these four is the function of the mitochondria? Recognition is easier, and that's the trap. If you study by rereading your notes, everything starts to look familiar, which isn't the same as being able to produce it. Then the exam puts four familiar-looking options in front of you and you can't tell which one is right.

The guide on judging what you know covers why that feeling of familiarity is a poor guide to what you'll remember on the day.

What the research says (and what it doesn't)

Taking multiple-choice tests helps you learn. Practice tests in general beat restudying (Adesope et al., 2017), and multiple-choice ones are no exception. Marsh, Roediger, Bjork and Bjork (2007) found that taking a multiple-choice test boosts performance on later tests compared with not being tested, and not just on simple definitions: the benefit held for SAT II questions and for items designed to test higher-level concepts.

But the wrong options can stick. Roediger and Marsh (2005) found a large benefit from prior multiple-choice testing on a later test, along with a cost. The more wrong options (researchers call them *lures*) students had read on the first test, the smaller the benefit, and students were more likely to give those lures as answers on the later test. In other words, a multiple-choice question can teach you a wrong fact if you pick the wrong option and never find out. Marsh and colleagues (2007) concluded that the benefits of testing still outweigh this cost.

Feedback fixes most of that. Butler and Roediger (2008) had students take a multiple-choice test with immediate feedback, delayed feedback or none. Both kinds of feedback increased correct answers and reduced lure answers on a later test, compared with no feedback. Practice questions without checking the answers are risky; with checking, they're one of the best things you can do.

Recall practice tends to help more, especially with feedback. In a college course, McDaniel and colleagues (2007) gave students weekly quizzes with feedback, either multiple-choice or short-answer, and then multiple-choice unit tests and a final. Quizzing helped and extra reading didn't, and short-answer quizzes produced more robust benefits than multiple-choice ones, even though the exams themselves were multiple choice. In lab experiments, Kang, McDermott and Roediger (2007) found that without feedback, a multiple-choice practice test did better than a short-answer one on a test three days later; with feedback, short-answer practice came out best. Their explanation was that the more demanding the retrieval, the bigger the benefit, as long as you find out what you got wrong.

It depends on whether you can actually retrieve the answer. Smith and Karpicke (2014) ran four experiments with 372 students comparing short-answer, multiple-choice and "hybrid" practice, where students tried to recall each answer first and then picked it from multiple-choice options. Every format improved learning a week later compared with only studying, on both verbatim and inference questions. But in three of the four experiments, short-answer and hybrid questions had little or no advantage over multiple choice. Only when students were better able to recall answers in the short-answer format did short-answer and hybrid practice pull ahead. So "always recall" isn't the whole story: recall practice helps most once you know the material well enough to succeed at it.

Good wrong options make multiple choice work harder for you. Little, Bjork, Bjork and Angello (2012) found that multiple-choice tests with plausible wrong options could trigger the same kind of productive retrieval as recall tests, if the alternatives were plausible enough that students had to retrieve why the right answer was right and why the wrong ones were wrong. They also found one advantage: multiple-choice practice improved later recall of information related to the wrong options, while recall tests did not.

Changing your answer usually isn't a mistake. Many students believe they should stick with their first instinct. Kruger, Wirtz and Miller (2005) noted that virtually all research on the question suggests otherwise: most answer changes go from wrong to right, and people who change answers usually improve their scores. They argued the myth persists because changing a right answer to a wrong one stings more ("if only I'd left it"), so those cases are easier to remember. In a study of 79 medical students'

end-of-term exams, answer changes were mostly from wrong to right; students who had been told about the benefits of changing answers when in doubt changed more answers and scored higher, though the difference in points gained was not statistically significant (Bauer et al., 2007).

What's missing. Much of this research uses lab materials (short passages, general-knowledge facts) or a few specific courses. We couldn't find solid studies of popular test-taking tricks such as "pick the longest answer" or "when in doubt, choose C," so we don't recommend them.

How to study for a multiple-choice exam

1. Recall first. For each topic, start with questions you answer without options: flashcards, short-answer questions, or a blurt of everything you remember. Cover the options of a practice question and answer it before you look. If you can produce the answer, picking it out later is easy.

2. Then practice in the format. Once you can recall most of a topic, do multiple-choice questions from past papers, the textbook or your instructor. This is where you get used to the wording, and to how close the wrong options can be. See how to use past papers.

3. Check every answer. Mark your practice immediately or at the end of the set, but always. For any you got wrong, read why the right answer is right.

4. Explain the wrong options. For each practice question, say in one line why each wrong option is wrong. That's the kind of thinking that made multiple choice work like recall in the research above, and it's also how you learn the distinctions the exam will test.

5. Turn misses into cards. Anything you got wrong, or got right by guessing, becomes a flashcard with the right answer on the back, reviewed on a spaced schedule.

6. Spread it out. A few sessions on different days beat one long session; see active recall vs rereading for the research on testing and the exam revision timetable for planning.

In the exam

These are practical habits, not research findings, except where noted:

- **Read the question stem first, and try to answer it before looking at the options.** Then find the option that matches.
- **Read every option** before choosing, even if the first one looks right.
- **Cross out options you can rule out,** and choose among what's left.
- **Don't get stuck.** Mark a hard question, move on and come back.
- **Change an answer when you have a reason,** such as a later question reminding you of something or noticing you misread the stem. The research above suggests changes help more often than they hurt (Kruger et al., 2005; Bauer et al., 2007). Don't change answers just because you feel nervous.
- **Find out the scoring rules.** If wrong answers lose marks, guessing works differently than if they don't. Your instructor or exam board can tell you.

If nerves make your mind go blank in the exam, the guide on exam anxiety can help.

Common mistakes

- **Rereading until everything looks familiar.** Familiar isn't the same as known, and close wrong options will show the difference.
- **Doing practice questions without checking them.** Wrong options you pick can stick.
- **Only practicing multiple choice.** Recall first makes recognition easy.
- **Memorizing practice-question answers** ("it was B") instead of the reason.
- **Trusting tricks** like "always pick the longest option."

Doing this in Atheneum

- **Quizzes with both formats.** Notebook quizzes mix multiple-choice questions (four choices) with short written answers, written from your notebook's material. You answer one question at a time, and the results show the correct answer and feedback for anything you missed. See Quizzes.
- **Review what you missed.** After a quiz, "Review this next" suggests summaries, study guides and flashcard decks in the notebook that cover the questions you got wrong.
- **Retake and raise the difficulty.** Every notebook quiz can be retaken, and new ones can be generated at beginner, intermediate or advanced difficulty. Review's **Up next** suggests a quiz you scored under 70% on before newer ones. See Review.
- **Recall practice.** Blurt Mode has you write what you remember about a file with it hidden, then Athena shows what you covered and left out. Flashcards are recall too: see Flashcards and spaced repetition.

Generating quizzes, decks and blurt checks uses AI credits.

A quick start

1. Pick one topic on your exam and write down everything you remember about it, notes closed.
2. Check it against your notes and make flashcards for what you missed.
3. Find ten multiple-choice questions on that topic. Cover the options and answer each one first, then choose.
4. Check every answer, and write one line on why each wrong option is wrong.
5. Turn anything you missed or guessed into a flashcard, and review it again in a day or two.

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GUIDE 35 · MEMORY · 11 MIN READ

How to Memorize for Med School: What the Evidence Supports

The best way to memorize in med school: retrieval and spacing, what Anki and Step 1 studies really show, keeping a deck manageable, mnemonics and sleep.

THE SHORT ANSWER

Test yourself instead of rereading, space your reviews over weeks, and get feedback on every miss. Trials in medical education support testing and spacing. Studies linking Anki to higher Step 1 scores are correlational, so they can't prove cause. Keep daily new cards at a pace you can sustain, understand before you memorize, and protect your sleep.

Medical school asks you to remember more facts, faster, than almost any other course: drug classes, nerve paths, enzyme deficiencies, the side effects of everything. Most students arrive with study habits that worked for smaller exams and find that rereading notes no longer keeps up. This guide covers what the research says about memorizing at this scale, what it doesn't say, and how to set up a routine you can sustain for years rather than weeks.

The bottom line: test yourself instead of rereading, space your reviews out over weeks and months, and check every miss against the answer. Those two ideas, retrieval and spacing, have been tested directly in medical students and residents. The popular claim that Anki raises board scores rests on correlational studies, which are encouraging but can't show cause and effect. And none of it works for long if you don't understand what you're memorizing or you sacrifice sleep to do it.

What the research says (and what it doesn't)

Testing beats restudying, in medical education too. Larsen, Butler and Roediger (2008) reviewed the cognitive psychology of the *testing effect* for medical educators. Laboratory studies show that repeated testing produces better retention than repeated study, especially when the tests are spaced out over time. Tests that require you to produce the answer, such as short-answer questions, help retention more than tests where you only recognize it, such as multiple choice. Feedback adds to the benefit, because it corrects errors and confirms correct answers.

The effect holds at six months. The same team then ran a randomized trial with pediatric and emergency medicine residents (Larsen et al., 2009). After a teaching session on two topics, each resident took short-answer tests with feedback on one topic and studied a review sheet on the other, three times over about a month. About six months later, scores on the tested topic averaged 39% against 26% for the studied one, a large effect (d = 0.91). Note how low both scores are: half a year is a long time, which is exactly why reviews have to keep coming back.

Spacing works for clinical knowledge. Kerfoot and colleagues (2007) randomized third-year students, after their urology rotation, to receive weekly emailed case scenarios and questions on two of four topics. Spaced education significantly improved end-of-year test scores, and the benefit was largest for students who had finished urology six to eleven months earlier, when the rest had had the most time to forget.

What about Anki and board scores? Several studies have linked Anki use to higher scores on the USMLE Step 1 exam. All of them are observational: they compare students who chose to use Anki with students who didn't.

- In a survey of 72 students at one school, the number of practice multiple-choice questions completed and the number of unique Anki cards seen both predicted Step 1 score, after accounting for MCAT score, preclinical grades and test anxiety. Roughly, each extra 445 practice questions or 1,700 unique Anki cards went with one more Step 1 point. Cards seen in a commercial flashcard product, Firecracker, did not predict score (Deng et al., 2015).
- A survey at another school found Anki use was associated with higher Step 1 scores, and among users, more consistent use went with higher scores (Lu et al., 2021).
- At a third school, 165 students responded, and 56% used Anki daily. Daily use correlated with a higher Step 1 score but not with Step 2 scores. The authors concluded that a variety of study methods can lead to similar outcomes (Wothe et al., 2023).

These results fit the trials above, but they can't prove Anki caused the higher scores. Students who keep a daily review habit for two years may differ in many other ways, such as motivation, time or prior preparation, that no survey fully captures. Treat them as "consistent with," not "proven by."

There's one more caveat. Step 1 has been reported as pass/fail only for exams taken on or after January 26, 2022 (USMLE, 2026), so these score studies come from the three-digit score era. The knowledge still matters, for Step 2 and for patients, but "points per card" is no longer something Step 1 reports.

Make retrieval the default

Every study session should involve producing answers from memory:

- **Flashcards** for discrete facts: a drug's mechanism, a nerve's root values, a classic lab finding.
- **Practice questions** for applying facts to a case. In the Deng study, practice questions were the strongest predictor of score.
- **Blank-page recall** for connected topics: write out a pathway or a differential from memory, then check it. The blurting guide explains how.

Rereading lecture slides feels productive because the material looks familiar, but familiarity is not the same as being able to recall it. The active recall guide covers that research in detail.

Always check the answer. Larsen's review found feedback strengthens the testing effect. After a missed question, read the explanation, then make a card for the specific fact you got wrong. A question bank is most useful as a list of what to fix.

Keep the volume manageable

The most common way students give up on spaced repetition in medical school is a review pile that grows faster than they can clear it. Every new card comes back many times, so the number you add each day sets your workload for weeks to come.

Anki's own FAQ on preparing for a large exam suggests a simple calculation: divide the number of cards you need to learn by the days you have, after taking off two to four weeks before the exam for consolidation and a few days for the ones you'll inevitably miss (Anki, 2026). That gives a daily number of new cards you can actually keep to.

Some practical rules (advice, not research):

- **Do your reviews before adding anything new.** If you're behind, pause new cards until the pile is back to normal.
- **Fix or delete cards you keep failing.** Anki calls these *leeches* and by default tags and suspends a card after eight lapses. Its manual says the most efficient fix is to change how the information is presented, since such cards often hold too much or are memorized without being understood (Anki, 2026).
- **Study in one big deck per course, not many tiny ones.** Kornell (2009) found that studying one large stack of flashcards beat studying four small stacks separately, because the large stack spaces each card further apart. Most learners believed the opposite.
- **Don't drop a card just because you got it right once.** Letting students set aside cards they thought they knew had small but consistently negative effects on learning (Kornell & Bjork, 2008).

Understand first, then memorize

A card on a fact you don't understand is hard to remember and easy to confuse with its neighbors. Anki's manual makes the same point: "Don't memorize without understanding" (Anki, 2026). Before you card a topic, make sure you could explain why it works the way it does. Learn the physiology, then card the numbers.

Pre-made decks can save typing, but the act of writing a card is part of the learning. In six experiments, students who made their own flashcards remembered more than students who studied premade ones (Pan et al., 2023). Those experiments used short educational passages, not a whole medical curriculum, so the trade-off is real: in a time-pressed year you may use shared decks, but writing cards for your weakest topics is worth the time. The guide to making good flashcards covers how.

Mnemonics, in their place

Medicine is famous for mnemonics, and they have a role, but a limited one. In a large review of study techniques, the *keyword mnemonic* (linking a term to a vivid sound-alike image) was rated low utility: it's hard to apply to many kinds of material and its benefits appeared mainly at short retention intervals (Dunlosky et al., 2013).

A memory palace can help with ordered lists. One study with medical students who built memory palaces for insulin and diabetes, under a teacher's supervision, found better assessment scores than a group taught with lectures and self-directed study (Qureshi et al., 2014). It was one topic at one school, and the memory-palace group also had an interactive session the other group didn't. The memory palace guide explains how to build one and where it falls short.

A reasonable rule: use a mnemonic for a list that has no logic of its own, such as the order of branches off an artery, and use understanding for everything that does. Then put the mnemonic itself on a card, so it gets spaced review like anything else.

Don't trade sleep for cards

When the workload rises, sleep is usually the first thing cut. The evidence suggests that costs more than it saves.

- **Sleep helps relearning.** In a study of 40 people learning foreign vocabulary in two sessions 12 hours apart, those who slept between the sessions needed half as much practice to relearn the words and remembered them much better a week and six months later than those who learned and relearned on the same day (Mazza et al., 2016).
- **Missing a night hurts thinking.** A meta-analysis of short-term total sleep deprivation found effects ranging from small and not significant on reasoning accuracy to large on lapses of simple attention (Lim & Dinges, 2010).
- In the Wothe survey, Anki use was also associated with better sleep quality, though, as with the scores, that's a correlation (Wothe et al., 2023).

A daily review habit lets you spread the work across the week instead of making up for it with late nights. The sleep and studying guide has more.

Doing this in Atheneum

Atheneum isn't built for medicine specifically, but its notebooks and Review tool cover the routine above.

- **One notebook per course or block.** Upload your lecture PDFs and keep your own notes in the notebook. See Notebooks.
- **Make or import decks.** Generate a flashcard deck from a notebook's files (it uses AI credits, and AI-written cards can be wrong, so check them against your material), or import your own cards from a text file. Atheneum reads Anki's plain-text export, up to 500 cards per import. It doesn't read `.apkg` packages, so images, audio and cloze formatting don't come across, and there's no editor for single cards. Shared decks built around images aren't a good fit. See Anki import and export.
- **Review what's due.** Every card has its own schedule, and you rate it Again, Hard, Good or Easy. Review gathers the due cards from a notebook so you can clear them in one session. See Flashcards and spaced repetition.

- **Practice questions.** Notebook quizzes give you questions from your own material, graded with feedback, and suggest what to review after a miss. They're written by an AI from your files, not board-style questions, so use them alongside a real question bank, not instead of one.
- **A daily goal.** Review has a daily goal and streak that counts cards rated and questions answered, which helps you keep the habit small and steady.

A quick start

1. Pick one lecture you've already understood and make 20 cards from it, one fact each, in your own words.
2. Work out your daily new-card number: cards to learn, divided by the days you have after a two- to four-week buffer before the exam.
3. Each day, clear your due reviews first, then add that day's new cards.
4. Do a block of practice questions each week and make a card for every fact you missed.
5. Once a week, rewrite or delete any card you keep failing.
6. Keep your sleep time fixed, and fit reviews into the day rather than the night.

The method isn't complicated. Recall, space, check your misses, and keep the pile small enough that you're still doing it in second year.

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GUIDE 36 · MEMORY · 10 MIN READ

How to Make Good Flashcards (That You'll Actually Remember)

How to make good flashcards: one idea per card, writing your own, both directions when it matters, cloze cards, pictures, and splitting up lists.

THE SHORT ANSWER

Good flashcards ask one clear question with one short answer, written in your own words. Experiments find that people remember self-made flashcards better than premade ones. Split lists into separate cards, use fill-in-the-blank cards for facts in a sentence, make reverse cards only where you need both directions, and rewrite any card you keep failing.

A deck of flashcards can be the most efficient study tool you own, or a pile of cards you dread opening. The difference is mostly in how the cards are written. A good card takes five seconds to answer and is easy to rate honestly. A bad one asks for a paragraph, has three possible answers, and keeps coming back because you never quite get it.

The bottom line: write your own cards, keep each one to a single idea with a short answer, and rewrite cards that keep failing. The research behind flashcards is strong on *why* they work: making something yourself, recalling it, and spacing your reviews all help memory. The specific rules for formatting a card come mostly from experienced users and the makers of flashcard software, not from experiments, so they're presented below as advice.

What the research says (and what it doesn't)

Making your own cards helps. People generally remember information better when they generate it themselves than when they simply read it. A meta-analysis of 86 studies put this *generation effect* at about 0.40, a benefit of almost half a standard deviation (Bertsch et al., 2007). Applied to flashcards: across six experiments, students who made their own digital flashcards from educational text passages remembered more two days later than students who studied premade ones, and in most cases did better on application questions too (Pan et al., 2023).

Recalling is what makes cards work. Taking a memory test improves later retention more than studying the same material again, even though rereading makes people feel more confident (Roediger & Karpicke, 2006). A flashcard is a small memory test, but only if you try to answer before you flip it. The active recall guide covers this research.

Spacing beats cramming, and students don't expect it. In Kornell's (2009) flashcard experiments, studying one large stack, which spaces each card further apart, beat studying four smaller stacks separately, and spacing also beat cramming on the last day. Spacing was more effective for 90% of participants, yet after the first session 72% believed massing had worked better. A survey of 374

undergraduates found that students understand the value of practicing a card more times but don't usually use, or see the benefit of, longer gaps between practice (Wissman et al., 2012). The spaced repetition guide explains how to schedule reviews.

Direction matters. In a study of Japanese students learning English word pairs, the direction they studied in affected what they learned. Productive learning (producing the word) led to larger gains in most of the kinds of word knowledge tested, while receptive learning (recalling the meaning when shown the word) led to larger gains in recognizing the meaning (Webb, 2009). Broadly, you get better at the direction you practice.

Taking cards out early backfires. Students often set aside cards they think they know. In four experiments, being allowed to drop flashcards had small but consistently negative effects on learning (Kornell & Bjork, 2008).

What's missing. We couldn't find controlled studies that test the formatting rules below directly, such as one idea per card versus several, or cloze cards versus questions. Those rules are widely shared advice, most of it going back to Piotr Wozniak's "twenty rules of formulating knowledge," written in 1999 by the creator of the SuperMemo software (Wozniak, 1999), and repeated in Anki's own manual (Anki, 2026). They're sensible, but they aren't proven the way spacing and retrieval are.

1. Understand it before you card it

Wozniak's first rule is "Do not learn if you do not understand," and Anki's manual says the same: "Don't memorize without understanding." A card on an idea you don't understand is hard to recall and easily confused with similar cards. Read the chapter, work through the example or explain the idea in your own words first. Then make cards for the facts you need to keep.

2. One idea per card

Wozniak calls this the *minimum information principle*: each card should ask for as little as possible. Anki's manual puts it as "keep it simple": the shorter your cards, the easier they are to review.

Too much	Better
Q: Describe the Dead Sea. A: A salt lake that is about 30% salt, so swimmers float easily and only simple organisms can live in it.	Q: Why do swimmers float easily in the Dead Sea? A: Its high salt content.
	Q: Why is the Dead Sea called "dead"? A: Only simple organisms can live in it.

That example is adapted from Wozniak's own. The long card has many parts, so you'll often remember some and not others, and it's hard to know whether to rate it Good or Again. Several small cards each have one right answer, and each gets its own schedule.

A quick test: if you can't say the answer in a few seconds, the card probably holds more than one idea.

3. Write the question so it has one answer

"What is important about mitochondria?" has a dozen right answers, so you'll never know if you got it. "Where in the cell does the citric acid cycle take place?" has one. Add whatever context rules out the wrong answer, such as the subject, the chapter, or "in plants" or "in humans." Context also helps you tell apart similar facts that would otherwise blur together; Wozniak calls this combating interference.

4. Write it in your own words

Copying a sentence from the textbook onto a card skips the part that does the most good. Rephrasing makes you process the idea, which is what the generation research suggests helps. Keep answers short, and keep the textbook's exact wording only for things that really are exact, like definitions you'll be marked on or formulas.

5. Premade decks: useful, with care

Pan and colleagues' experiments suggest that making your own cards beats studying someone else's. But making cards takes time, and premade decks can be accurate and well organized. A reasonable balance:

- Use a premade deck for broad, standard material, and still read each card before you study it.
- Delete cards on things your course doesn't cover.
- Write your own cards for topics you find hard, and rewrite any premade card you don't understand.

6. Both directions, but only where it matters

Some facts you need to recall both ways: a word and its meaning, a drug and its class, a country and its capital. Because you get better at the direction you practice (Webb, 2009), make a reverse card for these. Anki has a built-in "Basic (and reversed card)" note type that creates both from one note (Anki, 2026).

Don't reverse everything. "What does the mitral valve separate?" makes sense; its reverse ("What separates the left atrium from the left ventricle?") might too. But many cards have no useful reverse, and doubling a deck doubles its reviews.

7. Fill-in-the-blank (cloze) cards

A cloze card is a sentence with a word or phrase removed: "The [...] nerve supplies the diaphragm." Wozniak calls cloze deletion easy and effective, and suggests it especially for beginners who find it hard to keep cards short. Anki has a Cloze note type for this (Anki, 2026).

Two cautions (advice): blank out the part you actually need to know, not a filler word; and avoid sentences with so many blanks that the rest of the sentence gives the answer away.

8. Use pictures when the idea is visual

Anatomy, maps, graphs and diagrams are easier to hold as pictures than as sentences. Wozniak's rules include "use imagery," and Anki has an *image occlusion* note type that hides parts of an image for you to name, which its manual describes as especially useful for anatomy and geography (Anki, 2026). The dual coding guide covers what research says about words and pictures together.

9. Break lists into separate cards

"Name the eight causes of X" is one of the hardest cards to keep. You'll forget a different item each time, and the card keeps failing. Wozniak's advice is to avoid sets and lists where you can, and to handle the ones you can't with overlapping cloze cards, each one hiding one item with the others visible.

Some ways to break a list up (advice):

- One card per item, each asking for it from a different cue: "Which cause of X is associated with Y?"
- A cloze card per item, with the rest of the list shown.
- For a list you must know in order, a memory palace can help, with the list itself on a card for review.

10. Rewrite cards that keep failing

A card you keep getting wrong is usually a badly written card, not a hard fact. Anki calls these *leeches*, and its manual says the most efficient fix is to change how the information is presented, because such cards often hold too much information or are being memorized without being understood (Anki, 2026). Split it, add context, or go back to the source. Then rate the new card honestly, and don't remove cards just because you got them right a couple of times.

Common mistakes

- **Cards that are paragraphs.** Split them.
- **Questions with many right answers.** Add context until there's one.
- **Recognizing instead of recalling.** Answer before you flip; rate on what you produced, not what you recognized.
- **Making too many cards at once.** Every card comes back many times. Add new ones at a pace you can review.
- **Carding everything.** Cards suit facts and short relationships. For arguments and problem solving, practice and explanation work better.

Doing this in Atheneum

Atheneum's flashcards live in Review and in each notebook. There's no editor for single cards, so you write your own cards in a text file and import them.

- **Write cards in a text file.** One card per line: the front, a tab, then the back (comma-separated also works). For a card you need in both directions, add a second line with the two swapped. Then select **Import from Anki** on the Flashcards page in Review and choose the file. An import can hold up to 500 cards. See Anki import and export.
- **Moving cards from Anki.** Atheneum reads Anki's plain-text export, not `.apkg` files. Formatting is turned into plain text, images and audio don't come across, and cloze cards keep their `{{c1::…}}` text instead of becoming fill-in-the-blank cards, so plain question-and-answer cards travel best.
- **Generating a deck.** You can have Athena write a deck from a notebook's files and notes. It uses AI credits, and you didn't write those cards, so read each one against your material and expect to rewrite some. To change cards, edit them in a text file or Anki and import them as a new deck.
- **Studying.** Flip each card and rate it Again, Hard, Good or Easy. Each card gets its own due date. See Flashcards and spaced repetition. You can export any deck back to Anki.

If your source is a PDF or lecture slides, the guide to turning PDFs into flashcards shows how to pick what to card. If you're working at medical-school volume, see how to memorize for med school.

A quick start

1. Pick one section you already understand.
2. Write 10 cards, each with one question and an answer you can say in a few seconds, in your own words.
3. Turn any list into separate cards, and add a reverse card only where you need both directions.
4. Study them today, answering before you flip, then review what's due each day.
5. After a week, rewrite every card you've failed more than twice.

Small, clear and yours: that's a good card. The schedule does the rest.

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GUIDE 37 · EXAMS · 8 MIN READ

How to Study for an Open-Book Exam

Why open-book exams still need real revision, what research comparing open- and closed-book tests found, and how to prepare notes you can search fast.

THE SHORT ANSWER

Study for an open-book exam as if it were closed-book. In experiments, students who expected an open-book test studied less and did worse on a later closed-book test. Test yourself from memory, then build a short, well-organized set of notes with an index so that during the exam you only look up details, not whole topics.

"It's open book" sounds like good news. You can bring your notes, so surely there's less to learn. That's the trap. An open-book exam lets you look things up, but it doesn't give you time to learn them, and the questions are usually written so that looking things up won't be enough. Students who treat it as a lighter exam often find that out halfway through, flipping pages while the clock runs.

The bottom line: prepare for an open-book exam as if it were closed-book, then add one extra step at the end, organizing your materials so you can find a detail in seconds. Research comparing the two kinds of test suggests that expecting an open-book exam makes people study less, and that it shows on a later test.

What the research says (and what it doesn't)

Expecting an open-book test changes how you prepare. Agarwal and Roediger (2011) gave students passages to study, then a first test that was either open- or closed-book. In their first experiment, the open-book group did better on that first test, but two days later, on a closed-book test, both groups remembered about the same. In a second experiment, students were told in advance which kind of final test to expect. Those expecting an open-book test spent less time studying and did worse on the delayed closed-book comprehension and transfer tests, even though students preferred open-book tests.

The open-book advantage is short-lived. In an earlier study, Agarwal and colleagues (2008) had students study prose passages and then restudy them or take an open- or closed-book test. Open-book testing led to better scores at first, but the benefit didn't last: both kinds of test, taken with feedback, produced the same retention on a delayed test, and both beat restudying. Students also predicted they would remember more after restudying, even though testing helped more.

Material you planned to look up is the material you know least. In a study of medical students, Heijne-Penninga and colleagues (2011) had students prepare half of a course for a closed-book test and half for an open-book test, with some questions about each half asked in the other setting. Students scored lowest on closed-book questions about the open-book material. Among second-year students, those who took a deeper approach to learning needed less time on the open-book test.

Neither format is clearly better overall. A systematic review of 37 studies, with learners and subjects that varied, compared open- and closed-book exams (Durning et al., 2016). Students may prepare more extensively for closed-book exams, examinees appear to take longer to complete open-book exams, and the studies of exam performance favored closed-book exams, especially when students had prepared more for them. The authors concluded there wasn't enough evidence to use either format exclusively.

What's missing. The studies here are lab experiments, one medical school and a review written for medical educators, and none of them tests a specific open-book study routine. The advice below applies these findings and the wider research on practice testing; it isn't a proven method of its own.

Why "I can look it up" doesn't work

Three things make an open-book exam harder than it sounds:

- **Time.** Every lookup costs time. If you have to look up the basics, you'll run out before the hard questions. The review above found that people take longer on open-book exams.
- **The questions.** Examiners know you have your notes, so open-book questions often ask you to apply, compare, explain or evaluate, not to recall a definition. You can't look up an argument you haven't thought through.
- **Finding it.** You can only look up something if you know it's there and roughly where. That takes familiarity with the material, which only comes from studying it.

The useful way to think about your notes in the exam: they're for checking details (a formula's exact form, a date, a quotation, a case name), not for learning a topic for the first time.

Step 1: Revise as if it's closed-book

Do the same revision you would for any exam, with your notes closed while you practice.

- **Test yourself from memory.** Answer practice questions, use flashcards, or write out everything you remember about a topic and then check. The guide on active recall vs rereading explains why retrieval beats reading your notes again.
- **Practice the kinds of question you'll get.** If the exam asks you to apply ideas to new cases, practice that, not just recall. Past papers from the same course are the best source, especially past open-book papers.
- **Space it out.** Several short sessions across days and weeks work better than one long one. An exam revision timetable helps.

If you find yourself thinking "I don't need to learn this, I'll look it up," write that topic down. It's a sign of exactly the material the Heijne-Penninga study found students knew least.

Step 2: Decide what's worth looking up

Some things are worth having on paper even if you've learned them, because getting them exactly right matters:

- formulas, constants and units;
- exact definitions and quotations you'll want to cite word for word;
- names, dates, case names, section numbers;
- tables, data and diagrams you'll refer to.

Things you shouldn't be planning to look up: the main ideas of each topic, how the topics connect, and how to approach each type of question. Those have to be in your head.

Step 3: Build a reference you can search fast

Bringing everything you own isn't a strategy. A stack of 300 printed pages is slower to search than a short, well-organized set. Check your exam's rules first: what's allowed (printed notes, handwritten only, the textbook, annotations, a laptop), and whether there's a page limit.

Then build your reference:

1. **One summary per topic.** One or two pages each, in your own words: the key ideas, formulas and definitions, and a line on when each applies.
2. **A contents page and an index.** List topics with page numbers at the front. At the back, an alphabetical index of key terms with page numbers.
3. **Tabs or color codes.** Mark each topic's first page so you can open straight to it.
4. **A one-page "first look" sheet.** The formulas and facts you're most likely to need, all on one page.
5. **The textbook, marked up.** If it's allowed, tab the chapters you'll actually use. Don't plan to read it in the exam.

Writing these summaries is itself revision, but only if you write them from what you've learned rather than copying. Draft each one from memory first, then check it against your notes. The guide on organizing study notes covers keeping material for each subject in one place.

Step 4: Practice with your reference

Do at least one timed practice paper using only the materials you'll bring. You'll find out which lookups are slow, which pages you never opened and what's missing from your index. Fix them, then do another. Note how many times you looked something up: if it's every question, you need more revision, not better notes.

In the exam

- **Answer from memory first.** Write the answer you know, then check details in your notes.
- **Look things up with a purpose.** Know what you're looking for before you open your notes.
- **Watch the time.** Set a rough time per question and move on when it's up.
- **Don't copy long passages.** Most open-book exams reward your own explanation and application; copied text rarely earns the marks.

Common mistakes

- **Revising less** because it's open book.
- **Bringing everything** with no index, and losing time searching.
- **Planning to learn a topic in the exam** from your notes.
- **Never practicing with your materials** before the day.
- **Copying from notes** instead of answering the question.

Doing this in Atheneum

- **Keep the course together.** Upload lecture slides, readings and past papers (PDF or Word) to one notebook for the subject, in folders by topic. See Notebooks and Uploading files to a notebook.
- **Write your topic summaries as notes.** A notebook's Notes tab takes Markdown, with headings, lists and tables, and you can download each note as a `.md` file. See Notes in a notebook.
- **Print one book of the notebook.** Exporting a notebook as PDF gives you a cover, a contents page with every item listed, then file summaries, study guides, summaries, quizzes with an answer key, flashcards and your notes, with page numbers on every page. It's a starting point for a printed reference, if your exam allows printed notes. See Exporting a notebook as PDF.
- **Test yourself closed-book first.** Quizzes and flashcard decks in Review are made from the notebook's material, and Blurt Mode has you write what you remember about a file before Athena shows what you left out. See Quizzes, Flashcards and spaced repetition and Blurt Mode.
- **Time your practice paper.** The Pomodoro timer lets you set the focus length from 1 to 180 minutes, so you can match the exam's time limit.

A quick start

1. Check the exam rules: what you can bring, and any page limits.
2. Revise each topic with your notes closed, using practice questions or flashcards.
3. List the details worth looking up: formulas, definitions, quotations, names and dates.
4. Write a one- or two-page summary per topic, from memory first, then checked.
5. Add a contents page, an index and tabs, plus a one-page sheet of the most-used facts.
6. Do a timed practice paper with only those materials, and fix what was slow to find.

Treat your notes as a safety net, not a substitute. The less you need them on the day, the better they'll serve you.

Read next: how to study for a test the day before.

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GUIDE 38 · EXAMS · 9 MIN READ

How to Study for a Math Exam (and Actually Solve the Problems)

How to revise for a math test: solve problems instead of rereading solutions, mix problem types, space practice out, fade worked examples and learn from errors.

THE SHORT ANSWER

Study for a math exam by solving problems, not rereading solutions. Learn each method with worked examples, then practice mixed sets where you must choose the method, as classroom studies of interleaved practice support. Spread practice over several days, keep an error log, and finish with timed practice papers under exam conditions.

Math revision has a particular trap. You read through your notes and the worked solutions, every step makes sense, and you feel ready. Then in the exam, faced with a blank page and a question that doesn't say which chapter it's from, you can't get started. Following a solution and producing one are different skills, and only the second one is tested.

The bottom line: the way to study for a math exam is to solve problems, lots of them, mixed together so that you have to work out which method each one needs, spread over several days rather than crammed into one. Use worked examples to learn a method, then take them away. Keep a record of your mistakes and fix them.

What the research says (and what it doesn't)

Mixing problem types beats practicing them in blocks. Most textbook problem sets drill the method from the lesson you just learned, so you know which method to use before you read the question. In a lab study with college students, Rohrer and Taylor (2007) had students learn several kinds of problem and then practice them either blocked by type or randomly mixed. A week later, performance was vastly better after mixed practice.

The effect holds in real classrooms. In a study with 126 seventh-grade students, practice problems were arranged over three months so that skills were learned either by interleaved practice or the usual blocked approach. On an unannounced test, interleaved practice produced higher scores both 1 day later and 30 days later, with a larger effect at 30 days (Rohrer et al., 2015). A later preregistered, randomized controlled trial in 54 seventh-grade math classes ran for four months. One month after the practice ended, the interleaved group outscored the blocked group on an unannounced test, 61% versus 38% (Rohrer et al., 2020).

But the size of the benefit varies. A meta-analysis of 59 studies found a moderate interleaving effect overall, and a small one for studies that used mathematical tasks ($g = 0.34$). Interleaving worked best when the categories being mixed were similar to each other (Brunmair & Richter, 2019). In a large review

of study techniques, interleaved practice was rated moderately useful, because its benefits had only begun to be studied systematically, while practice testing and spacing were rated highly useful (Dunlosky et al., 2013).

Spacing beats doing more of the same. Rohrer and Taylor (2006) had college students practice one kind of math problem. Spreading ten problems over two sessions a week apart made no difference on a test one week later, but a very large difference four weeks later. In a second experiment, doing nine problems instead of three in one session (overlearning) had no effect on scores one or four weeks later. In that study, piling extra problems of the same type into one sitting didn't help later; spreading them out did.

Worked examples help, then you need to fade them out. A meta-analysis of 55 studies found that worked examples had a medium effect on math performance ($g = 0.48$), whether used to learn a skill or to practice it (Barbieri et al., 2023). Renkl and colleagues (2002) found that gradually removing solution steps from examples, until students solved problems on their own, fostered learning, and that it worked better to remove the last steps first.

Mistakes are useful when you correct them. Experiments on learning from errors indicate that making errors followed by corrective feedback helps learning, and that analyzing the reasoning that led to a mistake is crucial (Metcalfe, 2017). On studying *other people's* errors the evidence is mixed: in algebra classes, incorrect examples, alone or combined with correct ones, looked especially helpful for conceptual understanding (Booth et al., 2013), but the meta-analysis above found that correct examples alone produced larger effects than incorrect ones (Barbieri et al., 2023). Learning from your own errors is the safer bet.

What's missing. The classroom interleaving trials were in seventh grade, and much of the rest comes from lab studies. We found no controlled studies of the full revision routine below. It's a reasonable combination of these findings, not something proven as a package.

Step 1: Know what's on the exam

Get the syllabus or topic list, and list every type of problem that can come up: not just "integration," but "integration by substitution," "by parts," "partial fractions." This list drives everything else. Rate each type: can solve it reliably, can solve it with a reminder, can't solve it yet.

Collect problems for each type: the textbook's exercises, problem sheets, and especially past papers with their mark schemes or solutions.

Step 2: Learn each method, then fade the help

For a type you can't solve yet:

1. Study one or two worked examples. Cover each step and predict it before you look.
2. Try a similar problem with the last step left for you, then one with the last two steps left.
3. Solve one from scratch, with the solution hidden until you're done.

The guide on worked examples covers this in more detail, including when to stop using examples.

What not to do: read the solutions and nod. If you didn't produce the answer yourself, you haven't practiced the thing the exam tests.

Step 3: Mix the problem types

Once you can solve each type on its own, stop practicing them one at a time.

- **Build mixed sets.** Take problems from the last several topics and shuffle them. Remove or cover the section headings so the question doesn't tell you the method.
- **Name the method first.** Before solving, write one line: "this is a substitution problem, because…". Getting that wrong is the most useful mistake you can make in revision.
- **Put similar types side by side.** The meta-analysis found the benefit was largest when the things being mixed were similar, so mix the ones you tend to confuse.

Mixed practice feels harder and you'll get more wrong at first. That's expected. See the interleaving guide for more on why.

Step 4: Spread it over days

Plan several shorter sessions over the weeks before the exam rather than one long one. Come back to each problem type more than once, with a few days in between. If you only have a few days, still split your practice into sessions with sleep in between; the revision timetable guide shows how to plan it.

Step 5: Keep an error log

Every time you get a problem wrong, write one line:

Problem	Type	What went wrong	Kind of error	Fix
Sheet 4 Q3	Chain rule	Forgot to multiply by the inner derivative	Method	Redo 3 chain-rule problems tomorrow
2023 paper Q6	Simultaneous equations	Sign error in line 2	Careless	Check signs line by line
2022 paper Q9	Probability	Used "and" rule for an "or" event	Wrong method chosen	Add to mixed set with similar questions

Sort errors into kinds: **didn't know the method**, **chose the wrong method**, **method right but slipped** (signs, arithmetic, copying), and **ran out of time**. Each kind needs a different fix. Redo every problem you got wrong a few days later, without looking at your previous attempt.

Step 6: Practice under exam conditions

In the last week or two, do full papers or long mixed sections under the real time limit, with only the calculator and formula sheet you'll be allowed. Note where the time goes. If one problem type always takes too long, practice that type on its own under a timer.

A few habits for the exam itself:

- **Read the whole question** and underline what it asks for.
- **Write every step.** In many exams, working can earn marks even when the final answer is wrong; check your mark schemes.
- **Check the answer makes sense:** units, signs, order of magnitude.
- **Skip and come back** if you're stuck for more than a couple of minutes.

If nerves are what goes wrong under time pressure, see exam anxiety.

Common mistakes

- **Rereading solutions** instead of solving problems.
- **Drilling one type at a time** right up to the exam.
- **Doing 30 of the same problem** in one sitting.
- **Ignoring careless errors** as "not real mistakes." They cost the same marks.
- **Never practicing under time,** so pacing is a surprise on the day.

Doing this in Atheneum

- **Keep problems and solutions together.** Upload problem sheets, past papers and solutions to the subject's notebook, in folders by topic. See Uploading files to a notebook.
- **Keep your error log and faded examples as notes.** A notebook's Notes tab takes Markdown, including tables. See Notes in a notebook.
- **Ask Athena for a fresh problem.** After studying an example, ask Athena for a similar problem with different numbers, and to hold back the solution until you've tried. Check her working, since AI tutors can make calculation mistakes; the guide on studying with an AI tutor explains how.
- **Check concepts and method choice with quizzes.** Quizzes in Review, made from the whole notebook, mix multiple-choice and short written answers, so they can check whether you know which method fits and why. They don't replace solving problems on paper. See Quizzes.
- **Time your practice.** The Pomodoro timer lets you set the focus length from 1 to 180 minutes, so you can match a paper's time limit.
- **Space your sessions.** Put practice sessions and the exam in the calendar so they're spread out. See Calendar.

A quick start

1. List every problem type on the exam and rate each one.

2. For your weakest type, study two worked examples, then solve problems with less and less help.
3. Build a mixed set of 10 to 15 problems from different topics, headings hidden.
4. Name the method before solving each one, then check.
5. Log every wrong answer with its cause, and redo those problems in a few days.
6. In the last week, do at least one full paper under exam timing.

Math is learned by doing it. An hour of solving mixed problems will teach you more than an evening of reading perfect solutions.

Read next: how to study for a test the day before, for the last 24 hours.

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GUIDE 39 · EXAMS · 6 MIN READ

How to Study for a Test the Day Before

What still helps with 24 hours to go: test yourself instead of rereading, target weak spots, stop at a sensible time and sleep, and keep exam morning simple.

THE SHORT ANSWER

The day before a test, quiz yourself instead of rereading, because practice tests beat restudying on tests given days later. Spend most of the time on your weakest topics, stop at a sensible hour and sleep, since giving up sleep to study was linked to more trouble on next-day tests. On exam morning, warm up; don't learn new material.

It's the day before the test, and there's more to learn than there's time for. This guide is about making the best of that, honestly. One day can't do what a few weeks of spaced revision would have done, and nothing here will change that. But how you spend the next 24 hours still matters, and the most common instincts (reread everything, stay up late) are the ones that help least.

The bottom line: spend the day testing yourself, mostly on what you're weakest at; stop at a reasonable hour and sleep; and keep exam morning short and calm.

What the research says (and what it doesn't)

Testing beats rereading, even though rereading feels better. Roediger and Karpicke (2006) had students study prose passages and then either restudy them or take recall tests. On a test 5 minutes later, restudying came out ahead. On tests two days and a week later, the students who had tested themselves remembered substantially more, even though restudying made students more confident. A test the next day is closer to the delayed condition than to the 5-minute one. The guide on active recall vs rereading covers this research in more depth.

Cramming is worse than spacing, though it rarely feels that way. In flashcard experiments, Kornell (2009) found that spacing study out was more effective than cramming it into the last day before the test. Across the experiments, spacing beat massing for 90% of participants, yet after the first session, 72% of them believed massing had worked better. This is why the day before can't replace earlier revision. It's also why, if you have another exam later in the week, a short session on it today beats leaving it all for its own last day.

Giving up sleep to study tends to backfire the next day. A daily-diary study followed 535 high school students for two weeks in each of three school years. On days when a student gave up sleep to study more than usual, they had more trouble understanding material in class and were more likely to struggle on a test or assignment the next day, regardless of how much that student usually studied (Gillen-O'Neel

et al., 2013). In a lab study, one night without sleep weakened activity in the hippocampus, a brain region central to forming memories, while people learned new material, and they remembered less of it (Yoo et al., 2007). The guide on all-nighters goes into this.

Practice testing may protect memory under stress. In a lab study, people learned material either by restudying it or by taking practice tests. A day later, half were put under stress before being tested. Those who had restudied showed the usual stress-related drop in memory; those who had practiced retrieval did not (Smith et al., 2016). It's one study with lab stress, not a real exam, but it's one more reason to spend today testing yourself.

What's missing. We found no controlled studies of what to do specifically in the last 24 hours before an exam. The advice below applies the findings above to that day.

Step 1: Find your weak spots (30 minutes)

Don't start by rereading from page one. Start by finding out what you don't know.

- Take a practice quiz, or answer a few questions from each topic with your notes closed.
- Or blurt: for each topic, write down everything you remember in five minutes, then check what's missing.
- Sort topics into three piles: solid, shaky and lost.

Step 2: Spend most of the day on "shaky"

The topics you half know are where a few hours make the biggest difference. Solid topics need only a quick check; topics you've never studied at all may not be learnable in a day, so pick the parts most likely to come up.

For each shaky topic:

1. Reread the relevant notes once, briefly.
2. Close them and test yourself: practice questions, flashcards, or explain it out loud.
3. Check, fix what you got wrong, and test yourself again later in the day.

Work in focused blocks with short breaks, and come back to each topic more than once rather than finishing it in one long pass. In Kornell's experiments, spacing helped even within a session: studying one large stack of flashcards, so each card came back after a longer gap, beat studying several small stacks one at a time. For problem-based subjects, do problems, not readings; see how to study for a math exam.

Step 3: Make a one-page summary

In the late afternoon, write one page of the things you most need to remember: key formulas, definitions, the steps for common question types, and the mistakes you made today. Write it from memory first, then fill gaps from your notes. You'll read it once tomorrow morning. If the test is open-book, this is a good start on your reference sheet; see how to study for an open-book exam.

Step 4: Stop, and sleep

Pick a stopping time and stick to it. A last light review of your one-page summary is fine; starting a new topic at midnight isn't. Get your things ready for the morning (ID, pens, calculator, the allowed materials, the route and start time) so you don't have to think about them.

If you're tempted by an all-nighter, read should you pull an all-nighter? first. The sleep and studying guide covers what sleep does for memory.

Exam morning

- **Eat something and leave time to spare.**
- **Read your one-page summary,** once. Quiz yourself on a few items from it.
- **Don't start anything new,** and don't flip through whole chapters. It mostly creates panic about what you haven't covered.
- **Avoid last-minute comparing** with classmates if it makes you anxious.
- **Settle your nerves** if you need to. The guide on exam anxiety covers what's known to help.

Common mistakes

- **Rereading everything** from the start instead of testing yourself.
- **Spending the day on topics you already know,** because it feels good.
- **Staying up late** to fit in one more topic.
- **Learning new material on exam morning.**

Doing this in Atheneum

- **Find weak spots with a quiz.** In Review, a Quick quiz or a quiz you generate from the notebook checks what you know with your notes closed, and the results list topics to revisit. See Quizzes.
- **Blurt a file.** Blurt Mode has you write what you remember about a file, then Athena lists what you covered, partly covered and left out. See Blurt Mode.
- **Study the cards that are due.** If you've been using flashcard decks, Review's due-card session gives you the ones that need you most. See Flashcards and spaced repetition.
- **Work in blocks.** The Pomodoro timer runs focus rounds with short breaks between them.
- **Calm down before you go in.** Pomodoro's Breathing and Panic mode screens are guided exercises for the moment before an exam. See Breathing and panic mode.

A quick start

1. Spend 30 minutes testing yourself on every topic, notes closed.
2. Sort topics into solid, shaky and lost.
3. Spend most of the day on the shaky ones: brief reread, then test, fix and test again.
4. In the late afternoon, write a one-page summary from memory.
5. Pack your things, stop at your set time and go to sleep.

6. In the morning, read the summary once, quiz yourself on a few items and go.

And next time, if you can, start earlier: how to study for finals in a week and the exam revision timetable show how.

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