In this TED-ED lesson, Shai Marcu shows how sleep restructures your brain in a way that’s crucial for how our memory works.

TED-ED Lesson TRANSCRIPT:

It’s 4 a.m., and the big test is in eight hours, followed by a piano recital. You’ve been studying and playing for days, but you still don’t feel ready for either.

SO, WHAT CAN YOU DO?

Well, you can drink another cup of coffee and spend the next few hours cramming and practicing. But believe it or not, you might be better off closing the books, putting away the music, and going to sleep.

Sleep occupies nearly a third of our lives, but many of us give surprisingly little attention and care to it. This neglect is often the result of a major misunderstanding.

Sleep isn’t lost time, or just a way to rest when all our important work is done. Instead, it’s a critical function, during which your body balances and regulates its vital systems, affecting respiration and regulating everything from circulation to growth and immune response.

That’s great, but you can worry about all those things after this test, right? Well, not so fast.

It turns out that sleep is also crucial for your brain, with a fifth of your body’s circulatory blood being channeled to it as you drift off. And what goes on in your brain while you sleep is an intensely active period of restructuring that’s crucial for how our memory works.

At first glance, our ability to remember things doesn’t seem very impressive at all. 19th century psychologist Herman Ebbinghaus demonstrated that we normally forget 40% of new material within the first 20 minutes, a phenomenon known as the **forgetting curve**.

But this loss can be prevented through memory consolidation, the process by which information is moved from our fleeting short-term memory to our more durable long-term memory.

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This consolidation occurs with the help of a major part of the brain, known as the **hippocampus**. Its role in long-term memory formation was demonstrated in the 1950s by Brenda Milner in her research with a patient known as H.M.

After having his hippocampus removed, H.M.’s ability to form new short-term memories was damaged, but he was able to learn physical tasks through repetition.

Due to the removal of his hippocampus, H.M.’s ability to form long-term memories was also damaged. What this case revealed, among other things, was that the hippocampus was specifically involved in the consolidation of long-term declarative memory, such as the facts and concepts you need to remember for that test, rather than procedural memory, such as the finger movements you need to master for that recital.

Milner’s findings, along with work by Eric Kandel in the 90’s, have given us our current model of how this consolidation process works. Sensory data is initially transcribed and temporarily recorded in the neurons as short-term memory.

From there, it travels to the hippocampus, which strengthens and enhances the neurons in that cortical area.

Thanks to the phenomenon of **neuroplasticity**, new synaptic buds are formed, allowing new connections between neurons, and strengthening the neural network where the information will be returned as long-term memory.

SO WHY DO WE REMEMBER SOME THINGS AND NOT OTHERS?

Well, there are a few ways to influence the extent and effectiveness of memory retention. For example, memories that are formed in times of heightened feeling, or even stress, will be better recorded due to the hippocampus' link with emotion.

But one of the major factors contributing to memory consolidation is, you guessed it, a good night's sleep.

Sleep is composed of four stages, the deepest of which are known as **slow-wave sleep** and **rapid eye movement**. EEG machines monitoring people during these stages have shown electrical impulses moving between the brainstem, hippocampus, thalamus, and cortex, which serve as relay stations of memory formation.

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And the different stages of sleep have been shown to help consolidate different types of memories. During the non-REM slow-wave sleep, declarative memory is encoded into a temporary store in the anterior part of the hippocampus.

Through a continuing dialogue between the cortex and hippocampus, it is then repeatedly reactivated, driving its gradual redistribution to long-term storage in the cortex.

REM sleep, on the other hand, with its similarity to waking brain activity, is associated with the consolidation of procedural memory.

So based on the studies, going to sleep three hours after memorizing your formulas and one hour after practicing your scales would be the most ideal.

So hopefully you can see now that skimping on sleep not only harms your long-term health, but actually makes it less likely that you'll retain all that knowledge and practice from the previous night, all of which just goes to affirm the wisdom of the phrase, "Sleep on it."

When you think about all the internal restructuring and forming of new connections that occurs while you slumber, you could even say that proper sleep will have you waking up every morning with a new and improved brain, ready to face the challenges ahead.

Resources for Further Reading:

Sleep is Your Superpower: Matt Walker (Full Transcript)

Matthew Walker: The New Science of Sleep and Dreams (Transcript)

Brain Activity Revealed Through Your Skin: Stress, Sleep, & Seizures: Rosalind Picard (Transcript)

Robert Stickgold on Sleep, Memory and Dreams: Fitting the Pieces Together (Transcript)