

WEBVTT

NOTE duration:"00:18:43"

NOTE recognizability:0.934

NOTE language:en-us

NOTE Confidence: 0.9370376

00:00:24.350 --> 00:00:26.429 Good day. My name is Leo Cooney.

NOTE Confidence: 0.9370376

00:00:26.430 --> 00:00:28.830 I'm an emeritus professor of geriatrics

NOTE Confidence: 0.9370376

00:00:28.830 --> 00:00:31.178 at Yale, and I'm here today to talk

NOTE Confidence: 0.9370376

00:00:31.178 --> 00:00:33.350 to you about the biology of memory.

NOTE Confidence: 0.9370376

00:00:33.350 --> 00:00:35.390 So scientists have learned a

NOTE Confidence: 0.9370376

00:00:35.390 --> 00:00:37.837 dramatic amount about the process of

NOTE Confidence: 0.9370376

00:00:37.837 --> 00:00:39.865 memory over the past few decades.

NOTE Confidence: 0.9370376

00:00:39.870 --> 00:00:41.704 And it's very important because if we're

NOTE Confidence: 0.9370376

00:00:41.704 --> 00:00:43.955 going to, if we're going to develop

NOTE Confidence: 0.9370376

00:00:43.955 --> 00:00:46.469 treatments to prevent and treat memory loss,

NOTE Confidence: 0.9370376

00:00:46.470 --> 00:00:50.170 we need to know a lot about how the brain

NOTE Confidence: 0.9370376

00:00:50.265 --> 00:00:53.877 lays down and maintains stores memories.

NOTE Confidence: 0.9370376

00:00:53.880 --> 00:00:56.400 So what is memory? How does it work?

NOTE Confidence: 0.9370376

00:00:56.400 --> 00:00:58.596 How does it change with aging?
NOTE Confidence: 0.9370376

00:00:58.600 --> 00:01:01.344 So memory is the capacity of an
NOTE Confidence: 0.9370376

00:01:01.344 --> 00:01:04.233 Organism to acquire, store and recover
NOTE Confidence: 0.9370376

00:01:04.233 --> 00:01:06.517 information based on experience.
NOTE Confidence: 0.9370376

00:01:06.520 --> 00:01:07.997 So there are two types of memory.
NOTE Confidence: 0.9370376

00:01:08.000 --> 00:01:09.086 There's declarative memory,
NOTE Confidence: 0.9370376

00:01:09.086 --> 00:01:12.120 which is a memory for facts and events,
NOTE Confidence: 0.9370376

00:01:12.120 --> 00:01:14.520 for people, places and objects.
NOTE Confidence: 0.9370376

00:01:14.520 --> 00:01:16.120 This memory requires the
NOTE Confidence: 0.9370376

00:01:16.120 --> 00:01:17.320 medial temporal lobe,
NOTE Confidence: 0.9370376

00:01:17.320 --> 00:01:19.135 and in particular the structure
NOTE Confidence: 0.9370376

00:01:19.135 --> 00:01:20.587 called the hippocampus that
NOTE Confidence: 0.9370376

00:01:20.587 --> 00:01:22.298 we'll be talking a lot about.
NOTE Confidence: 0.9370376

00:01:22.300 --> 00:01:24.490 Procedural memory is knowing how to
NOTE Confidence: 0.9370376

00:01:24.490 --> 00:01:26.832 do things, for example, motor skills,
NOTE Confidence: 0.9370376

00:01:26.832 --> 00:01:30.272 and that involves a number of brain systems

NOTE Confidence: 0.9370376

00:01:30.272 --> 00:01:33.576 depending upon the specific type of learning.

NOTE Confidence: 0.9370376

00:01:33.580 --> 00:01:35.580 So what is memory,

NOTE Confidence: 0.9370376

00:01:35.580 --> 00:01:37.580 Where is it encoded,

NOTE Confidence: 0.9370376

00:01:37.580 --> 00:01:39.464 where is it stored?

NOTE Confidence: 0.9370376

00:01:39.464 --> 00:01:41.819 How do nerves acquire memory?

NOTE Confidence: 0.9370376

00:01:41.820 --> 00:01:44.140 How do nerves store memory?

NOTE Confidence: 0.9370376

00:01:44.140 --> 00:01:47.927 And how are these processes disturbed in

NOTE Confidence: 0.9370376

00:01:47.927 --> 00:01:50.599 neurologic conditions such as dementia?

NOTE Confidence: 0.9370376

00:01:50.600 --> 00:01:52.760 So where is information encoded

NOTE Confidence: 0.9370376

00:01:52.760 --> 00:01:54.920 and stored in the memory?

NOTE Confidence: 0.9370376

00:01:54.920 --> 00:01:57.840 So the brain is made-up of a number of lobes.

NOTE Confidence: 0.9370376

00:01:57.840 --> 00:02:01.360 We want to focus today on two of those lobes.

NOTE Confidence: 0.9370376

00:02:01.360 --> 00:02:04.640 The first one is the medial temporal lobe,

NOTE Confidence: 0.9370376

00:02:04.640 --> 00:02:07.238 where shortterm memories are laid down

NOTE Confidence: 0.9370376

00:02:07.238 --> 00:02:10.199 in a structure called the hippocampus,

NOTE Confidence: 0.9370376

00:02:10.200 --> 00:02:11.957 and the other is the frontal lobe,
NOTE Confidence: 0.9370376

00:02:11.960 --> 00:02:14.354 sometimes called the cortex of the brain.
NOTE Confidence: 0.9370376

00:02:14.360 --> 00:02:18.574 And that's where longterm memory are stored.
NOTE Confidence: 0.9370376

00:02:18.580 --> 00:02:21.177 So the anatomical components of the medial
NOTE Confidence: 0.9370376

00:02:21.177 --> 00:02:23.460 temporal lobe support declarative memory,
NOTE Confidence: 0.9370376

00:02:23.460 --> 00:02:25.220 and again, that's the hippocampus
NOTE Confidence: 0.9370376

00:02:25.220 --> 00:02:26.980 and the power hippocampal gyrus.
NOTE Confidence: 0.9370376

00:02:26.980 --> 00:02:29.205 The hippocampus and related structures
NOTE Confidence: 0.9370376

00:02:29.205 --> 00:02:32.422 are essential for the formation of memory
NOTE Confidence: 0.9370376

00:02:32.422 --> 00:02:34.737 and its reorganization and consolidation.
NOTE Confidence: 0.9370376

00:02:34.740 --> 00:02:35.712 After learning,
NOTE Confidence: 0.9370376

00:02:35.712 --> 00:02:38.142 medial temporal lobe structures have
NOTE Confidence: 0.9370376

00:02:38.142 --> 00:02:40.938 a temporary role in memory storage,
NOTE Confidence: 0.9370376

00:02:40.940 --> 00:02:43.856 so the hippocampus rapidly stores the
NOTE Confidence: 0.9370376

00:02:43.856 --> 00:02:46.060 day's events before the information
NOTE Confidence: 0.9370376

00:02:46.060 --> 00:02:48.520 is transferred to the cortex for

NOTE Confidence: 0.9370376

00:02:48.520 --> 00:02:50.109 reorganization and classification.

NOTE Confidence: 0.9370376

00:02:50.110 --> 00:02:53.146 The hippocampus is a temporary repository.

NOTE Confidence: 0.9370376

00:02:53.150 --> 00:02:56.366 Waking patterns of nerve activity are

NOTE Confidence: 0.9370376

00:02:56.366 --> 00:02:59.070 reinstated and replayed during sleep,

NOTE Confidence: 0.9370376

00:02:59.070 --> 00:03:01.734 so sleep is very important to

NOTE Confidence: 0.9370376

00:03:01.734 --> 00:03:03.066 the brain's activities.

NOTE Confidence: 0.9370376

00:03:03.070 --> 00:03:06.556 So good sleep pattern is very important

NOTE Confidence: 0.9370376

00:03:06.556 --> 00:03:09.828 for strong memories and a healthy brain.

NOTE Confidence: 0.9370376

00:03:09.830 --> 00:03:12.714 Memories are assumed to decay more rapidly

NOTE Confidence: 0.9370376

00:03:12.714 --> 00:03:15.309 in the hippocampus than in the cortex.

NOTE Confidence: 0.9370376

00:03:15.310 --> 00:03:17.950 So when we study Alzheimer's disease,

NOTE Confidence: 0.9370376

00:03:17.950 --> 00:03:19.980 the structure where the first

NOTE Confidence: 0.9370376

00:03:19.980 --> 00:03:21.604 changes of Alzheimer's disease

NOTE Confidence: 0.9370376

00:03:21.604 --> 00:03:23.669 are found is the hippocampus.

NOTE Confidence: 0.9370376

00:03:23.670 --> 00:03:25.740 And that's logical because the hippocampus

NOTE Confidence: 0.9370376

00:03:25.740 --> 00:03:28.256 is where short term memories are stored

NOTE Confidence: 0.9370376

00:03:28.256 --> 00:03:30.398 and the first symptom of Alzheimer's

NOTE Confidence: 0.9370376

00:03:30.398 --> 00:03:32.426 disease is loss of short term memory.

NOTE Confidence: 0.9370376

00:03:32.430 --> 00:03:34.260 So the hippocampus is an important

NOTE Confidence: 0.9370376

00:03:34.260 --> 00:03:36.192 structure as we talk about memory

NOTE Confidence: 0.9370376

00:03:36.192 --> 00:03:38.148 and the things that affect memory.

NOTE Confidence: 0.9370376

00:03:38.150 --> 00:03:38.770 The cortex,

NOTE Confidence: 0.9370376

00:03:38.770 --> 00:03:40.630 or frontal part of the brain,

NOTE Confidence: 0.9370376

00:03:40.630 --> 00:03:42.975 is an outer layer of nerve activity

NOTE Confidence: 0.9370376

00:03:42.975 --> 00:03:44.909 of the cerebrum of the brain.

NOTE Confidence: 0.93262696

00:03:44.910 --> 00:03:47.208 It's the largest site of nerve

NOTE Confidence: 0.93262696

00:03:47.208 --> 00:03:49.176 integration in the central nervous

NOTE Confidence: 0.93262696

00:03:49.176 --> 00:03:51.703 system has a key role in attention,

NOTE Confidence: 0.93262696

00:03:51.710 --> 00:03:54.161 perception, awareness, thought,

NOTE Confidence: 0.93262696

00:03:54.161 --> 00:03:57.429 memory, language and consciousness.

NOTE Confidence: 0.93262696

00:03:57.430 --> 00:03:59.974 But it's also important because it's

NOTE Confidence: 0.93262696

00:03:59.974 --> 00:04:02.870 the site of longterm memory storage.

NOTE Confidence: 0.93262696

00:04:02.870 --> 00:04:05.162 So the hippocampus rapidly stores the

NOTE Confidence: 0.93262696

00:04:05.162 --> 00:04:07.262 day's events before the information

NOTE Confidence: 0.93262696

00:04:07.262 --> 00:04:10.304 is transferred to the cortex for

NOTE Confidence: 0.93262696

00:04:10.304 --> 00:04:11.825 reorganization and reclassification.

NOTE Confidence: 0.93262696

00:04:11.830 --> 00:04:14.470 The hippocampus is a temporary repository.

NOTE Confidence: 0.93262696

00:04:14.470 --> 00:04:18.270 The cortex is important for long term memory.

NOTE Confidence: 0.93262696

00:04:18.270 --> 00:04:21.868 So how do nerve cells store memory?

NOTE Confidence: 0.93262696

00:04:21.870 --> 00:04:22.955 So there are three components

NOTE Confidence: 0.93262696

00:04:22.955 --> 00:04:23.823 of a nerve cell.

NOTE Confidence: 0.93262696

00:04:23.830 --> 00:04:26.548 There's a body, there's an Axon,

NOTE Confidence: 0.93262696

00:04:26.550 --> 00:04:30.001 and that's a branching structure that carries

NOTE Confidence: 0.93262696

00:04:30.001 --> 00:04:32.998 nerve impulses away from the cell body.

NOTE Confidence: 0.93262696

00:04:33.000 --> 00:04:35.358 A dendrite is another branching structure,

NOTE Confidence: 0.93262696

00:04:35.360 --> 00:04:38.552 but that's the receiving part of the

NOTE Confidence: 0.93262696

00:04:38.552 --> 00:04:41.568 neuron that brings messages to the cell.

NOTE Confidence: 0.93262696

00:04:41.568 --> 00:04:44.040 It receives its input from axons

NOTE Confidence: 0.93262696

00:04:44.122 --> 00:04:46.720 at a structure called the synapse.

NOTE Confidence: 0.93262696

00:04:46.720 --> 00:04:48.680 The synapse is very important.

NOTE Confidence: 0.93262696

00:04:48.680 --> 00:04:52.341 That's the site of chemical and electrical

NOTE Confidence: 0.93262696

00:04:52.341 --> 00:04:54.833 communication between nerve cells at

NOTE Confidence: 0.93262696

00:04:54.833 --> 00:04:57.353 the junction of axons and dendrites.

NOTE Confidence: 0.93262696

00:04:57.360 --> 00:05:00.493 So here is an Axon branching

NOTE Confidence: 0.93262696

00:05:00.493 --> 00:05:02.858 structure leaving a nerve cell,

NOTE Confidence: 0.93262696

00:05:02.860 --> 00:05:05.135 taking impulses away from the nerve cell.

NOTE Confidence: 0.93262696

00:05:05.140 --> 00:05:07.084 Here was a dendrite,

NOTE Confidence: 0.93262696

00:05:07.084 --> 00:05:09.028 another branching structure taking

NOTE Confidence: 0.93262696

00:05:09.028 --> 00:05:11.340 impulses back to the nerve cell.

NOTE Confidence: 0.93262696

00:05:11.340 --> 00:05:13.140 And here is the synapse,

NOTE Confidence: 0.93262696

00:05:13.140 --> 00:05:14.166 Very, very important.

NOTE Confidence: 0.93262696

00:05:14.166 --> 00:05:18.019 So at the end of the Axon there are vesicles,

NOTE Confidence: 0.93262696

00:05:18.020 --> 00:05:20.780 and those vesicles contain chemicals,

NOTE Confidence: 0.93262696

00:05:20.780 --> 00:05:22.929 and those chemicals in the way in

NOTE Confidence: 0.93262696

00:05:22.929 --> 00:05:25.059 which nerve cells talk to each other.

NOTE Confidence: 0.93262696

00:05:25.060 --> 00:05:28.036 So we call those chemicals neurotransmitters.

NOTE Confidence: 0.93262696

00:05:28.040 --> 00:05:29.800 They're released by the Axon.

NOTE Confidence: 0.93262696

00:05:29.800 --> 00:05:31.955 They're received by what's called

NOTE Confidence: 0.93262696

00:05:31.955 --> 00:05:33.679 receptors on the dendrite.

NOTE Confidence: 0.93262696

00:05:33.680 --> 00:05:36.662 And that's the way messages are

NOTE Confidence: 0.93262696

00:05:36.662 --> 00:05:38.558 passed from nerve cell to nerve cell.

NOTE Confidence: 0.93262696

00:05:38.560 --> 00:05:42.067 But it's also this synapse is the

NOTE Confidence: 0.93262696

00:05:42.067 --> 00:05:44.639 place where memory is stored.

NOTE Confidence: 0.93262696

00:05:44.640 --> 00:05:46.920 So there's a pivotal role of the synapse

NOTE Confidence: 0.93262696

00:05:46.920 --> 00:05:49.080 in the neurochemistry of memory.

NOTE Confidence: 0.93262696

00:05:49.080 --> 00:05:51.702 It stores memory by changing the

NOTE Confidence: 0.93262696

00:05:51.702 --> 00:05:54.360 strength of that synaptic connection.

NOTE Confidence: 0.93262696

00:05:54.360 --> 00:05:56.440 We call that synaptic plasticity.
NOTE Confidence: 0.93262696

00:05:56.440 --> 00:05:58.228 We'll talk more about that later.
NOTE Confidence: 0.93262696

00:05:58.230 --> 00:06:00.828 Long Term Potentiation is a process.
NOTE Confidence: 0.93262696

00:06:00.830 --> 00:06:03.470 It's the process by which the
NOTE Confidence: 0.93262696

00:06:03.470 --> 00:06:04.790 synapse is strengthened.
NOTE Confidence: 0.93262696

00:06:04.790 --> 00:06:07.394 It increases the transmission
NOTE Confidence: 0.93262696

00:06:07.394 --> 00:06:09.347 between nerve cells.
NOTE Confidence: 0.93262696

00:06:09.350 --> 00:06:12.990 So synapses are the essential unit of memory.
NOTE Confidence: 0.93262696

00:06:12.990 --> 00:06:15.366 They're the site of electrical and
NOTE Confidence: 0.93262696

00:06:15.366 --> 00:06:17.350 chemical communication between nerve cells.
NOTE Confidence: 0.93262696

00:06:17.350 --> 00:06:20.068 And because the strength of these
NOTE Confidence: 0.93262696

00:06:20.068 --> 00:06:21.880 synaptic connections are modifiable,
NOTE Confidence: 0.93262696

00:06:21.880 --> 00:06:22.612 they're considered plastic.
NOTE Confidence: 0.93262696

00:06:22.612 --> 00:06:24.076 If you go to the dictionary,
NOTE Confidence: 0.93262696

00:06:24.080 --> 00:06:25.280 look up the word plastic,
NOTE Confidence: 0.93262696

00:06:25.280 --> 00:06:27.080 you realize that it means

NOTE Confidence: 0.93262696
00:06:27.080 --> 00:06:28.520 capable of being molded.
NOTE Confidence: 0.93262696
00:06:28.520 --> 00:06:30.560 So these synapses are capable
NOTE Confidence: 0.93262696
00:06:30.560 --> 00:06:32.600 of being changed or molded,
NOTE Confidence: 0.93262696
00:06:32.600 --> 00:06:35.240 and that's what impacts memory.
NOTE Confidence: 0.93262696
00:06:35.240 --> 00:06:37.020 So changes in synaptic strength
NOTE Confidence: 0.93262696
00:06:37.020 --> 00:06:39.242 are brought about by the release
NOTE Confidence: 0.93262696
00:06:39.242 --> 00:06:41.480 of these chemicals from the Axon,
NOTE Confidence: 0.93262696
00:06:41.480 --> 00:06:42.416 the neurotransmitters.
NOTE Confidence: 0.93262696
00:06:42.416 --> 00:06:44.288 Some changes in synaptic
NOTE Confidence: 0.93262696
00:06:44.288 --> 00:06:46.160 strength last only seconds,
NOTE Confidence: 0.93262696
00:06:46.160 --> 00:06:47.924 others persist over the
NOTE Confidence: 0.93262696
00:06:47.924 --> 00:06:49.688 lifetime of the Organism,
NOTE Confidence: 0.93262696
00:06:49.690 --> 00:06:52.320 And thousands of experiments over
NOTE Confidence: 0.93262696
00:06:52.320 --> 00:06:55.663 decades have shown over and over
NOTE Confidence: 0.93262696
00:06:55.663 --> 00:06:58.768 again that synaptic plasticity at
NOTE Confidence: 0.93262696

00:06:58.768 --> 00:07:01.252 appropriate synapses is necessary
NOTE Confidence: 0.93262696

00:07:01.344 --> 00:07:04.500 for memory formation and for the
NOTE Confidence: 0.93262696

00:07:04.500 --> 00:07:06.604 storage of that information.
NOTE Confidence: 0.93262696

00:07:06.610 --> 00:07:09.010 Persistent strengthening of the synapse,
NOTE Confidence: 0.93262696

00:07:09.010 --> 00:07:12.307 which leads to long lasting increase in
NOTE Confidence: 0.93262696

00:07:12.307 --> 00:07:14.264 signal transmissions between neurons
NOTE Confidence: 0.93262696

00:07:14.264 --> 00:07:17.060 again is called Long term Potentiation.
NOTE Confidence: 0.93262696

00:07:17.060 --> 00:07:18.985 It follows high frequency stimulation
NOTE Confidence: 0.93262696

00:07:18.985 --> 00:07:21.770 of the synapse and it's one of
NOTE Confidence: 0.93262696

00:07:21.770 --> 00:07:23.755 the major cellular reactions that
NOTE Confidence: 0.93262696

00:07:23.755 --> 00:07:24.946 underlies learning and
NOTE Confidence: 0.92836356

00:07:25.018 --> 00:07:27.680 memory. And when a synapse has been
NOTE Confidence: 0.92836356

00:07:27.680 --> 00:07:30.220 affected by Long Term Potentiation,
NOTE Confidence: 0.92836356

00:07:30.220 --> 00:07:32.534 you see a mark of that. That is,
NOTE Confidence: 0.92836356

00:07:32.534 --> 00:07:35.173 the spine of the dendrite gets thickened.
NOTE Confidence: 0.92836356

00:07:35.180 --> 00:07:37.020 And when you see thickening

NOTE Confidence: 0.92836356

00:07:37.020 --> 00:07:38.492 of the dendrite spine,

NOTE Confidence: 0.92836356

00:07:38.500 --> 00:07:40.621 you know that a memory has been

NOTE Confidence: 0.92836356

00:07:40.621 --> 00:07:42.499 laid down in that synapse.

NOTE Confidence: 0.92836356

00:07:42.500 --> 00:07:44.786 So Long Term Potentiation is one

NOTE Confidence: 0.92836356

00:07:44.786 --> 00:07:46.952 of the several phenomena which

NOTE Confidence: 0.92836356

00:07:46.952 --> 00:07:48.659 produce synaptic plasticity,

NOTE Confidence: 0.92836356

00:07:48.660 --> 00:07:50.260 the ability of chemical synapses

NOTE Confidence: 0.92836356

00:07:50.260 --> 00:07:51.540 to change their strength.

NOTE Confidence: 0.92836356

00:07:51.540 --> 00:07:52.580 Chemical neurotransmitters,

NOTE Confidence: 0.92836356

00:07:52.580 --> 00:07:54.660 again we've shown before,

NOTE Confidence: 0.92836356

00:07:54.660 --> 00:07:56.300 are released from the Axon.

NOTE Confidence: 0.92836356

00:07:56.300 --> 00:07:58.120 They activate post synaptic

NOTE Confidence: 0.92836356

00:07:58.120 --> 00:07:59.940 receptors on the dendrite.

NOTE Confidence: 0.92836356

00:07:59.940 --> 00:08:02.316 They're followed by an influx of

NOTE Confidence: 0.92836356

00:08:02.316 --> 00:08:04.470 electrolytes called sodium and calcium,

NOTE Confidence: 0.92836356

00:08:04.470 --> 00:08:06.264 and the rise of calcium inside
NOTE Confidence: 0.92836356

00:08:06.264 --> 00:08:08.435 the cell is the most critical
NOTE Confidence: 0.92836356

00:08:08.435 --> 00:08:10.710 trigger for long term potentiation.
NOTE Confidence: 0.92836356

00:08:10.710 --> 00:08:12.708 So this is how memory works.
NOTE Confidence: 0.92836356

00:08:12.710 --> 00:08:15.070 It's how nerve cells talk to each other.
NOTE Confidence: 0.92836356

00:08:15.070 --> 00:08:17.140 So multiple studies have demonstrated
NOTE Confidence: 0.92836356

00:08:17.140 --> 00:08:19.650 the role of changing the strength
NOTE Confidence: 0.92836356

00:08:19.650 --> 00:08:21.485 of a synaptic connection to
NOTE Confidence: 0.92836356

00:08:21.485 --> 00:08:23.630 the laying down of memories.
NOTE Confidence: 0.92836356

00:08:23.630 --> 00:08:26.360 Long Term Potentiation is the process by
NOTE Confidence: 0.92836356

00:08:26.360 --> 00:08:28.629 which these connections are strengthened,
NOTE Confidence: 0.92836356

00:08:28.630 --> 00:08:30.223 and Longterm Potentiation
NOTE Confidence: 0.92836356

00:08:30.223 --> 00:08:32.347 thickens the dendritic spines,
NOTE Confidence: 0.92836356

00:08:32.350 --> 00:08:35.430 which indicates the laying down of memory.
NOTE Confidence: 0.92836356

00:08:35.430 --> 00:08:36.870 Now where does protein
NOTE Confidence: 0.92836356

00:08:36.870 --> 00:08:38.310 synthesis come into this?

NOTE Confidence: 0.92836356

00:08:38.310 --> 00:08:40.398 What is the role of protein

NOTE Confidence: 0.92836356

00:08:40.398 --> 00:08:41.790 synthesis in memory storage?

NOTE Confidence: 0.92836356

00:08:41.790 --> 00:08:43.815 So usually when we think

NOTE Confidence: 0.92836356

00:08:43.815 --> 00:08:45.030 of protein synthesis,

NOTE Confidence: 0.92836356

00:08:45.030 --> 00:08:48.108 we think of proteins being those

NOTE Confidence: 0.92836356

00:08:48.108 --> 00:08:50.670 essential components for our skin,

NOTE Confidence: 0.92836356

00:08:50.670 --> 00:08:51.814 our muscles, our bones,

NOTE Confidence: 0.92836356

00:08:51.814 --> 00:08:53.096 our heart, our liver,

NOTE Confidence: 0.92836356

00:08:53.096 --> 00:08:54.508 our lungs, our kidneys,

NOTE Confidence: 0.92836356

00:08:54.510 --> 00:08:56.220 all of those organs in the

NOTE Confidence: 0.92836356

00:08:56.220 --> 00:08:57.990 body are made-up of proteins.

NOTE Confidence: 0.92836356

00:08:57.990 --> 00:09:01.338 The protein has another role and

NOTE Confidence: 0.92836356

00:09:01.338 --> 00:09:04.553 the other role for a protein

NOTE Confidence: 0.92836356

00:09:04.553 --> 00:09:06.723 is the storage of memories.

NOTE Confidence: 0.92836356

00:09:06.723 --> 00:09:09.309 So protein synthesis is the process

NOTE Confidence: 0.92836356

00:09:09.309 --> 00:09:11.790 of creating protein molecules.
NOTE Confidence: 0.92836356

00:09:11.790 --> 00:09:14.310 It's necessary for late phase,
NOTE Confidence: 0.92836356

00:09:14.310 --> 00:09:16.090 long term potentiation and the
NOTE Confidence: 0.92836356

00:09:16.090 --> 00:09:17.870 storage of long term memory.
NOTE Confidence: 0.92836356

00:09:17.870 --> 00:09:19.395 So we need these proteins
NOTE Confidence: 0.92836356

00:09:19.395 --> 00:09:20.920 to have long term memory.
NOTE Confidence: 0.92836356

00:09:20.920 --> 00:09:22.789 So the way in which the proteins
NOTE Confidence: 0.92836356

00:09:22.789 --> 00:09:24.600 are created are from amino acids.
NOTE Confidence: 0.92836356

00:09:24.600 --> 00:09:26.880 We have 20 amino acids in our body,
NOTE Confidence: 0.92836356

00:09:26.880 --> 00:09:28.716 11 are produced by our body,
NOTE Confidence: 0.92836356

00:09:28.720 --> 00:09:30.360 but nine have to come from our diet.
NOTE Confidence: 0.92836356

00:09:30.360 --> 00:09:33.120 They're called the essential amino acids.
NOTE Confidence: 0.92836356

00:09:33.120 --> 00:09:35.115 So we're going to talk about transcription,
NOTE Confidence: 0.92836356

00:09:35.120 --> 00:09:37.484 which is the process by which
NOTE Confidence: 0.92836356

00:09:37.484 --> 00:09:39.060 the messenger RNA template
NOTE Confidence: 0.92836356

00:09:39.139 --> 00:09:41.153 is transcribed from the DNA,

NOTE Confidence: 0.92836356

00:09:41.153 --> 00:09:43.118 the gene inside the nucleus.

NOTE Confidence: 0.92836356

00:09:43.120 --> 00:09:45.394 Translation is a process by which

NOTE Confidence: 0.92836356

00:09:45.394 --> 00:09:47.831 amino acids are linked together on

NOTE Confidence: 0.92836356

00:09:47.831 --> 00:09:51.100 the messenger RNA to create proteins.

NOTE Confidence: 0.92836356

00:09:51.100 --> 00:09:52.310 So transcription,

NOTE Confidence: 0.92836356

00:09:52.310 --> 00:09:53.790 the definition of the transcription,

NOTE Confidence: 0.92836356

00:09:53.790 --> 00:09:56.430 is a process in which information

NOTE Confidence: 0.92836356

00:09:56.430 --> 00:09:57.310 is rewritten.

NOTE Confidence: 0.92836356

00:09:57.310 --> 00:10:01.335 So when Watson and Crick first identified

NOTE Confidence: 0.92836356

00:10:01.335 --> 00:10:04.830 the double Helix here back in 1953,

NOTE Confidence: 0.92836356

00:10:04.830 --> 00:10:06.750 they learned several things.

NOTE Confidence: 0.92836356

00:10:06.750 --> 00:10:07.350 One of them,

NOTE Confidence: 0.92836356

00:10:07.350 --> 00:10:07.950 the double Helix.

NOTE Confidence: 0.92836356

00:10:07.950 --> 00:10:10.830 The 2nd is that what bonded

NOTE Confidence: 0.92836356

00:10:10.830 --> 00:10:13.404 those double Helix together were

NOTE Confidence: 0.92836356

00:10:13.404 --> 00:10:15.672 for nitrogen containing nuclear
NOTE Confidence: 0.92836356

00:10:15.672 --> 00:10:18.507 bases and they are cytosine,
NOTE Confidence: 0.92836356

00:10:18.510 --> 00:10:18.937 guanine,
NOTE Confidence: 0.92836356

00:10:18.937 --> 00:10:20.218 adenine and thymine.
NOTE Confidence: 0.92836356

00:10:20.218 --> 00:10:22.780 So not only are those the
NOTE Confidence: 0.92836356

00:10:22.862 --> 00:10:24.650 important neural bases,
NOTE Confidence: 0.92836356

00:10:24.650 --> 00:10:27.583 but Watson and Crick realized that wherever
NOTE Confidence: 0.92836356

00:10:27.583 --> 00:10:30.607 they found adenine in DNA there was Thymine,
NOTE Confidence: 0.92836356

00:10:30.610 --> 00:10:32.806 wherever they found cytosine in DNA,
NOTE Confidence: 0.92836356

00:10:32.810 --> 00:10:34.076 there was guanine.
NOTE Confidence: 0.92836356

00:10:34.076 --> 00:10:37.030 So they realized that these bases were
NOTE Confidence: 0.92836356

00:10:37.106 --> 00:10:39.416 together and the base pairing rule
NOTE Confidence: 0.92836356

00:10:39.416 --> 00:10:42.288 is the essence of the genetic code.
NOTE Confidence: 0.92836356

00:10:42.290 --> 00:10:44.666 So the way in which DNA
NOTE Confidence: 0.92836356

00:10:44.666 --> 00:10:46.250 replicates itself when a
NOTE Confidence: 0.93425804

00:10:46.338 --> 00:10:49.229 cell divides and you need more DNA.

NOTE Confidence: 0.93425804

00:10:49.230 --> 00:10:52.227 If the mother DNA has adenine on a site,

NOTE Confidence: 0.93425804

00:10:52.230 --> 00:10:54.390 the daughter DNA will have thymine.

NOTE Confidence: 0.93425804

00:10:54.390 --> 00:10:57.387 If the mother DNA has cytosine at a site,

NOTE Confidence: 0.93425804

00:10:57.390 --> 00:11:00.030 the daughter DNA will have wanting.

NOTE Confidence: 0.93425804

00:11:00.030 --> 00:11:03.130 So that base pairing rule

NOTE Confidence: 0.93425804

00:11:03.130 --> 00:11:05.492 allows replication of DNA,

NOTE Confidence: 0.93425804

00:11:05.492 --> 00:11:09.508 but the same base pairing rules allows the

NOTE Confidence: 0.93425804

00:11:09.510 --> 00:11:13.303 DNA to transmit the genetic code to the RNA.

NOTE Confidence: 0.93425804

00:11:13.303 --> 00:11:16.156 The only difference is on RNA you

NOTE Confidence: 0.93425804

00:11:16.156 --> 00:11:18.214 have uracil as opposed to thymine.

NOTE Confidence: 0.93425804

00:11:18.220 --> 00:11:20.416 So if the DNA has adenine,

NOTE Confidence: 0.93425804

00:11:20.420 --> 00:11:22.580 the RNA will have uracil.

NOTE Confidence: 0.93425804

00:11:22.580 --> 00:11:24.596 If the DNAA cytosine,

NOTE Confidence: 0.93425804

00:11:24.596 --> 00:11:26.720 the RNA will have guanine.

NOTE Confidence: 0.93425804

00:11:26.720 --> 00:11:28.745 So you need the genetic

NOTE Confidence: 0.93425804

00:11:28.745 --> 00:11:30.816 code is found in the DNA,
NOTE Confidence: 0.93425804

00:11:30.820 --> 00:11:34.501 but that code has to be transmitted to what's
NOTE Confidence: 0.93425804

00:11:34.501 --> 00:11:38.080 called messenger RNA to produce proteins.
NOTE Confidence: 0.93425804

00:11:38.080 --> 00:11:40.460 So the genetic code,
NOTE Confidence: 0.93425804

00:11:40.460 --> 00:11:44.600 each amino acid is coded for
NOTE Confidence: 0.93425804

00:11:44.600 --> 00:11:47.162 by three RNA nuclear bases.
NOTE Confidence: 0.93425804

00:11:47.162 --> 00:11:49.132 And this genetic code not
NOTE Confidence: 0.93425804

00:11:49.132 --> 00:11:51.150 only codes for amino acids,
NOTE Confidence: 0.93425804

00:11:51.150 --> 00:11:53.075 but it codes for starting the process
NOTE Confidence: 0.93425804

00:11:53.075 --> 00:11:55.230 and it codes for ending the process.
NOTE Confidence: 0.93425804

00:11:55.230 --> 00:11:58.206 So the structure that has a shopping cot
NOTE Confidence: 0.93425804

00:11:58.206 --> 00:12:01.745 full of amino acids is called the ribosome.
NOTE Confidence: 0.93425804

00:12:01.750 --> 00:12:03.230 So the ribosome comes by,
NOTE Confidence: 0.93425804

00:12:03.230 --> 00:12:05.492 looks down on the messenger RNA
NOTE Confidence: 0.93425804

00:12:05.492 --> 00:12:07.232 and sees uracil, uracil, uracil.
NOTE Confidence: 0.93425804

00:12:07.232 --> 00:12:09.038 The ribosome knows I have to

NOTE Confidence: 0.93425804

00:12:09.038 --> 00:12:11.030 need to put down phenylalanine.

NOTE Confidence: 0.93425804

00:12:11.030 --> 00:12:14.026 If the ribosome seems uracil uracil adenine,

NOTE Confidence: 0.93425804

00:12:14.030 --> 00:12:15.766 they cut down leucine.

NOTE Confidence: 0.93425804

00:12:15.766 --> 00:12:18.370 If they say see uracilcytosine adenine,

NOTE Confidence: 0.93425804

00:12:18.370 --> 00:12:20.698 they put down cellarine and so forth until

NOTE Confidence: 0.93425804

00:12:20.698 --> 00:12:23.327 they go through all 20 of the amino acids.

NOTE Confidence: 0.93425804

00:12:23.330 --> 00:12:24.068 And again,

NOTE Confidence: 0.93425804

00:12:24.068 --> 00:12:26.651 the code also tells the ribosome to

NOTE Confidence: 0.93425804

00:12:26.651 --> 00:12:29.410 stop the process tells them to start,

NOTE Confidence: 0.93425804

00:12:29.410 --> 00:12:31.370 tells them what amino acids to put down,

NOTE Confidence: 0.93425804

00:12:31.370 --> 00:12:33.729 and then tells them when to stop.

NOTE Confidence: 0.93425804

00:12:33.730 --> 00:12:37.237 So translation is the process in which

NOTE Confidence: 0.93425804

00:12:37.237 --> 00:12:40.216 proteins are synthesized in cells after

NOTE Confidence: 0.93425804

00:12:40.216 --> 00:12:43.190 the transcription of DNA to messenger RNA.

NOTE Confidence: 0.93425804

00:12:43.190 --> 00:12:46.779 It's the way in which genes are expressed,

NOTE Confidence: 0.93425804

00:12:46.780 --> 00:12:48.964 and the messenger RNA is decoded
NOTE Confidence: 0.93425804

00:12:48.964 --> 00:12:51.233 on a structure called the ribosome
NOTE Confidence: 0.93425804

00:12:51.233 --> 00:12:53.459 to produce an amino acid chain,
NOTE Confidence: 0.93425804

00:12:53.460 --> 00:12:56.379 which is then folded into a protein.
NOTE Confidence: 0.93425804

00:12:56.380 --> 00:12:59.122 So the synthesis of specific proteins
NOTE Confidence: 0.93425804

00:12:59.122 --> 00:13:02.030 is what determines whether a synaptic
NOTE Confidence: 0.93425804

00:13:02.030 --> 00:13:05.030 or memory process remains transient or
NOTE Confidence: 0.93425804

00:13:05.030 --> 00:13:07.537 becomes persistently stored in the brain.
NOTE Confidence: 0.93425804

00:13:07.540 --> 00:13:09.598 So we need this protein synthesis
NOTE Confidence: 0.93425804

00:13:09.598 --> 00:13:11.698 process to occur if we're going
NOTE Confidence: 0.93425804

00:13:11.698 --> 00:13:13.684 to be able to store memories.
NOTE Confidence: 0.93425804

00:13:13.690 --> 00:13:15.980 So proteins either strengthen A
NOTE Confidence: 0.93425804

00:13:15.980 --> 00:13:17.354 preexisting synaptic connection
NOTE Confidence: 0.93425804

00:13:17.354 --> 00:13:19.369 or form new connections.
NOTE Confidence: 0.93425804

00:13:19.370 --> 00:13:20.970 Proteins can be synthesized locally
NOTE Confidence: 0.93425804

00:13:20.970 --> 00:13:23.271 in nerve cells and what are called

NOTE Confidence: 0.93425804

00:13:23.271 --> 00:13:24.871 the dendrites in response to

NOTE Confidence: 0.93425804

00:13:24.871 --> 00:13:26.490 changes in synaptic plasticity.

NOTE Confidence: 0.93425804

00:13:26.490 --> 00:13:28.570 So if we talk about the memory process,

NOTE Confidence: 0.93425804

00:13:28.570 --> 00:13:31.698 a key feature of it is the synthesis

NOTE Confidence: 0.93425804

00:13:31.698 --> 00:13:34.688 of proteins to allow long term memory.

NOTE Confidence: 0.93425804

00:13:34.690 --> 00:13:37.406 So proteins are as important to the

NOTE Confidence: 0.93425804

00:13:37.406 --> 00:13:39.876 preservation of memories as they are to

NOTE Confidence: 0.93425804

00:13:39.876 --> 00:13:42.130 the construction of organs in the body.

NOTE Confidence: 0.93425804

00:13:42.130 --> 00:13:44.150 These proteins must be programmed

NOTE Confidence: 0.93425804

00:13:44.150 --> 00:13:46.170 by DNA to preserve memories,

NOTE Confidence: 0.93425804

00:13:46.170 --> 00:13:48.150 and these proteins connect

NOTE Confidence: 0.93425804

00:13:48.150 --> 00:13:50.130 with strengthened synapses to

NOTE Confidence: 0.93425804

00:13:50.130 --> 00:13:52.648 lay down and store memories.

NOTE Confidence: 0.93425804

00:13:52.650 --> 00:13:55.530 So how is memory constructed?

NOTE Confidence: 0.93425804

00:13:55.530 --> 00:13:57.714 So memory is not a literal

NOTE Confidence: 0.93425804

00:13:57.714 --> 00:13:59.170 reproduction of the past,
NOTE Confidence: 0.93425804

00:13:59.170 --> 00:14:01.228 but it's a constructive process in
NOTE Confidence: 0.93425804

00:14:01.228 --> 00:14:03.981 which bits of pieces of information from
NOTE Confidence: 0.93425804

00:14:03.981 --> 00:14:06.166 various sources are pulled together.
NOTE Confidence: 0.93425804

00:14:06.170 --> 00:14:08.468 So constituent features of a memory
NOTE Confidence: 0.93425804

00:14:08.468 --> 00:14:10.000 are distributed widely across
NOTE Confidence: 0.9398001

00:14:10.061 --> 00:14:11.766 different parts of the brain.
NOTE Confidence: 0.9398001

00:14:11.770 --> 00:14:15.716 No single location contains a memory that
NOTE Confidence: 0.9398001

00:14:15.716 --> 00:14:18.646 corresponds to a specific experience.
NOTE Confidence: 0.9398001

00:14:18.650 --> 00:14:21.530 So retrieval of past experience involves
NOTE Confidence: 0.9398001

00:14:21.530 --> 00:14:24.410 a process of pattern completion,
NOTE Confidence: 0.9398001

00:14:24.410 --> 00:14:27.272 and the disparate features that constitute
NOTE Confidence: 0.9398001

00:14:27.272 --> 00:14:30.554 an episode must be linked or bound
NOTE Confidence: 0.9398001

00:14:30.554 --> 00:14:33.564 together in a process we call encoding.
NOTE Confidence: 0.9398001

00:14:33.570 --> 00:14:35.826 So memory is not a unitary
NOTE Confidence: 0.9398001

00:14:35.826 --> 00:14:37.330 faculty of the mind,

NOTE Confidence: 0.9398001

00:14:37.330 --> 00:14:39.345 but it's composed of multiple

NOTE Confidence: 0.9398001

00:14:39.345 --> 00:14:41.360 systems that have different operating

NOTE Confidence: 0.9398001

00:14:41.429 --> 00:14:43.779 principles and different neuro anatomy.

NOTE Confidence: 0.9398001

00:14:43.780 --> 00:14:45.025 There's conscious declarative

NOTE Confidence: 0.9398001

00:14:45.025 --> 00:14:47.100 memory about facts and events,

NOTE Confidence: 0.9398001

00:14:47.100 --> 00:14:48.760 and that's expressed through recollection

NOTE Confidence: 0.9398001

00:14:48.760 --> 00:14:51.500 as a way of modeling the external world.

NOTE Confidence: 0.9398001

00:14:51.500 --> 00:14:54.015 But there's also unconscious non

NOTE Confidence: 0.9398001

00:14:54.015 --> 00:14:56.027 declarative memory ability such

NOTE Confidence: 0.9398001

00:14:56.027 --> 00:14:58.620 as skills and habit learning,

NOTE Confidence: 0.9398001

00:14:58.620 --> 00:15:01.860 and that's expressed through performance.

NOTE Confidence: 0.9398001

00:15:01.860 --> 00:15:05.068 So memory is also needs to be consolidated.

NOTE Confidence: 0.9398001

00:15:05.070 --> 00:15:08.073 So a newly formed memory needs to

NOTE Confidence: 0.9398001

00:15:08.073 --> 00:15:10.030 undergo a transformative process,

NOTE Confidence: 0.9398001

00:15:10.030 --> 00:15:13.132 becomes stronger and more resilient over

NOTE Confidence: 0.9398001

00:15:13.132 --> 00:15:16.350 time until it's insensitive to disruption.
NOTE Confidence: 0.9398001

00:15:16.350 --> 00:15:19.052 So consolidation of many types of memory
NOTE Confidence: 0.9398001

00:15:19.052 --> 00:15:21.590 first depends upon hippocampal process.
NOTE Confidence: 0.9398001

00:15:21.590 --> 00:15:22.841 Hippocampal processing during
NOTE Confidence: 0.9398001

00:15:22.841 --> 00:15:24.509 the first few weeks,
NOTE Confidence: 0.9398001

00:15:24.510 --> 00:15:27.020 but subsequently needs to become
NOTE Confidence: 0.9398001

00:15:27.020 --> 00:15:29.028 independent of the hippocampus.
NOTE Confidence: 0.9398001

00:15:29.030 --> 00:15:31.642 So memory consolidation again
NOTE Confidence: 0.9398001

00:15:31.642 --> 00:15:34.907 requires RNA and protein synthesis.
NOTE Confidence: 0.9398001

00:15:34.910 --> 00:15:37.514 There needs to be an active
NOTE Confidence: 0.9398001

00:15:37.514 --> 00:15:39.250 communication between the cortex
NOTE Confidence: 0.9398001

00:15:39.325 --> 00:15:42.061 and the hippocampus to transfer new
NOTE Confidence: 0.9398001

00:15:42.061 --> 00:15:44.736 memories in the hippocampus to long
NOTE Confidence: 0.9398001

00:15:44.736 --> 00:15:47.070 term memories stored in the cortex.
NOTE Confidence: 0.9398001

00:15:47.070 --> 00:15:49.406 So there needs to be an active integration
NOTE Confidence: 0.9398001

00:15:49.406 --> 00:15:51.508 between the cortex and the hippocampus.

NOTE Confidence: 0.9398001

00:15:51.510 --> 00:15:53.826 But that's during off time periods

NOTE Confidence: 0.9398001

00:15:53.826 --> 00:15:54.984 such as sleep,

NOTE Confidence: 0.9398001

00:15:54.990 --> 00:15:56.500 and that plays an important

NOTE Confidence: 0.9398001

00:15:56.500 --> 00:15:57.708 role in memory consolidation.

NOTE Confidence: 0.9398001

00:15:57.710 --> 00:15:58.418 So again,

NOTE Confidence: 0.9398001

00:15:58.418 --> 00:16:01.250 we need to have good sleep patterns to

NOTE Confidence: 0.9398001

00:16:01.331 --> 00:16:04.355 have strong memories and a healthy brain.

NOTE Confidence: 0.9398001

00:16:04.360 --> 00:16:06.382 So the cortex and the hippocampus

NOTE Confidence: 0.9398001

00:16:06.382 --> 00:16:07.730 play complementary roles in

NOTE Confidence: 0.9398001

00:16:07.794 --> 00:16:09.398 memory formation and storage,

NOTE Confidence: 0.9398001

00:16:09.400 --> 00:16:11.380 with a cortex reflecting long

NOTE Confidence: 0.9398001

00:16:11.380 --> 00:16:13.360 term memory and the hippocampus

NOTE Confidence: 0.9398001

00:16:13.433 --> 00:16:15.317 reflecting short term memory.

NOTE Confidence: 0.9398001

00:16:15.320 --> 00:16:18.559 Now we also have found out that

NOTE Confidence: 0.9398001

00:16:18.559 --> 00:16:21.673 patients with dementia have defects in

NOTE Confidence: 0.9398001

00:16:21.673 --> 00:16:25.156 these processes in both the synaptic
NOTE Confidence: 0.9398001

00:16:25.156 --> 00:16:27.600 plasticity and protein synthesis.
NOTE Confidence: 0.9398001

00:16:27.600 --> 00:16:30.498 So deflex and defects in memory
NOTE Confidence: 0.9398001

00:16:30.498 --> 00:16:32.430 storage results from pathological
NOTE Confidence: 0.9398001

00:16:32.509 --> 00:16:35.729 changes in the fundamental mechanisms
NOTE Confidence: 0.9398001

00:16:35.729 --> 00:16:38.305 undergoing longterm synaptic plasticity.
NOTE Confidence: 0.9398001

00:16:38.310 --> 00:16:40.146 Disruption in gene expression
NOTE Confidence: 0.9398001

00:16:40.146 --> 00:16:42.900 occurs in the brains of patients
NOTE Confidence: 0.9398001

00:16:42.978 --> 00:16:44.829 with Alzheimer's disease,
NOTE Confidence: 0.9398001

00:16:44.830 --> 00:16:45.740 the nucleolus,
NOTE Confidence: 0.9398001

00:16:45.740 --> 00:16:48.470 which is where proteins are synthesized.
NOTE Confidence: 0.9398001

00:16:48.470 --> 00:16:50.675 The size of that is decreased in
NOTE Confidence: 0.9398001

00:16:50.675 --> 00:16:52.179 postmortem studies of patients
NOTE Confidence: 0.9398001

00:16:52.179 --> 00:16:53.667 with Alzheimer's disease,
NOTE Confidence: 0.9398001

00:16:53.670 --> 00:16:55.935 and PET scans have demonstrated
NOTE Confidence: 0.9398001

00:16:55.935 --> 00:16:58.200 that protein synthesis is decreased

NOTE Confidence: 0.9398001

00:16:58.271 --> 00:17:00.636 in the frontal cortex patients

NOTE Confidence: 0.9398001

00:17:00.636 --> 00:17:02.055 with Alzheimer's disease.

NOTE Confidence: 0.9398001

00:17:02.060 --> 00:17:04.830 So this information is important

NOTE Confidence: 0.9398001

00:17:04.830 --> 00:17:07.572 to understanding, if you will,

NOTE Confidence: 0.9398001

00:17:07.572 --> 00:17:09.748 the pathophysiology or causes

NOTE Confidence: 0.9398001

00:17:09.748 --> 00:17:11.380 for dementing illnesses.

NOTE Confidence: 0.9398001

00:17:11.380 --> 00:17:12.748 So in summary,

NOTE Confidence: 0.9398001

00:17:12.748 --> 00:17:14.572 memories are usually immediately

NOTE Confidence: 0.9398001

00:17:14.572 --> 00:17:16.900 encoded in the hippocampus.

NOTE Confidence: 0.9398001

00:17:16.900 --> 00:17:19.010 Long term memory is stored

NOTE Confidence: 0.9398001

00:17:19.010 --> 00:17:20.698 in the frontal cortex,

NOTE Confidence: 0.9398001

00:17:20.700 --> 00:17:23.000 synapses are the essential

NOTE Confidence: 0.9398001

00:17:23.000 --> 00:17:25.300 nerve unit of memory,

NOTE Confidence: 0.9398001

00:17:25.300 --> 00:17:27.855 and memory is stored by changes in

NOTE Confidence: 0.9398001

00:17:27.855 --> 00:17:30.151 the strength of synaptic connections

NOTE Confidence: 0.9398001

00:17:30.151 --> 00:17:32.966 that we call synaptic plasticity.

NOTE Confidence: 0.9398001

00:17:32.970 --> 00:17:34.026 Protein synthesis,

NOTE Confidence: 0.9398001

00:17:34.026 --> 00:17:34.554 however,

NOTE Confidence: 0.9398001

00:17:34.554 --> 00:17:38.250 is also necessary for long late phase,

NOTE Confidence: 0.9398001

00:17:38.250 --> 00:17:40.210 long term potentiation and the

NOTE Confidence: 0.9398001

00:17:40.210 --> 00:17:42.170 storage of long term memory.

NOTE Confidence: 0.9398001

00:17:42.170 --> 00:17:45.422 Genetic DNA is just is transcribed

NOTE Confidence: 0.9398001

00:17:45.422 --> 00:17:47.048 to messenger RNA,

NOTE Confidence: 0.9398001

00:17:47.050 --> 00:17:50.062 which uses the genetic code to

NOTE Confidence: 0.9398001

00:17:50.062 --> 00:17:51.568 produce these proteins.

NOTE Confidence: 0.9398001

00:17:51.570 --> 00:17:53.654 Memories are constructed from

NOTE Confidence: 0.9398001

00:17:53.654 --> 00:17:55.738 pieces of information distributed

NOTE Confidence: 0.9398001

00:17:55.738 --> 00:17:57.999 throughout the brain and pulled

NOTE Confidence: 0.9398001

00:17:57.999 --> 00:17:59.919 together to create a pattern.

NOTE Confidence: 0.9398001

00:17:59.920 --> 00:18:02.070 So memory consolidation is a

NOTE Confidence: 0.9398001

00:18:02.070 --> 00:18:04.220 process in which newly formed

NOTE Confidence: 0.9340937

00:18:04.303 --> 00:18:06.788 and unstable memories are transformed

NOTE Confidence: 0.9340937

00:18:06.788 --> 00:18:09.273 into stable long term memory.

NOTE Confidence: 0.9340937

00:18:09.280 --> 00:18:10.924 They require a specific

NOTE Confidence: 0.9340937

00:18:10.924 --> 00:18:12.157 patent of connections,

NOTE Confidence: 0.9340937

00:18:12.160 --> 00:18:16.157 and they require RNA and protein synthesis.

NOTE Confidence: 0.9340937

00:18:16.160 --> 00:18:18.996 Finally, defects in synaptic

NOTE Confidence: 0.9340937

00:18:18.996 --> 00:18:21.832 plasticity and protein synthesis

NOTE Confidence: 0.9340937

00:18:21.832 --> 00:18:24.730 are seen in patients with dementia.

NOTE Confidence: 0.9340937

00:18:24.730 --> 00:18:26.950 So scientists have taught us an

NOTE Confidence: 0.9340937

00:18:27.015 --> 00:18:29.193 enormous amount about the process by

NOTE Confidence: 0.9340937

00:18:29.193 --> 00:18:31.799 which the brain lays down and stores

NOTE Confidence: 0.9340937

00:18:31.799 --> 00:18:33.965 memory in the past several decades.

NOTE Confidence: 0.9340937

00:18:33.970 --> 00:18:35.734 But a lot more work needs to

NOTE Confidence: 0.9340937

00:18:35.734 --> 00:18:38.081 be done so that we can develop

NOTE Confidence: 0.9340937

00:18:38.081 --> 00:18:39.605 interventions to both prevent

NOTE Confidence: 0.9340937

00:18:39.605 --> 00:18:41.729 and treat dementing illnesses,

NOTE Confidence: 0.9340937

00:18:41.730 --> 00:18:42.998 thank you very much.