Bio101 Lecture 19 Part 3 - Cerebrum and memory

0:00:00.050,0:00:05.400
hello and welcome to lecture 19 part 3
in this part we're going to be talking

0:00:05.400,0:00:09.000
about the functions of the cerebrum and
we're also going to cover a bit of

0:00:09.000,0:00:16.020
memory this material is found in chapter
12 of the Marieb textbook so before we

0:00:16.020,0:00:20.010
begin let's just talk about an overview
of the cerebrum we talked about the

0:00:20.010,0:00:25.710
general anatomy of the brain itself in
one of the previous parts but we want to

0:00:25.710,0:00:30.359
cover the anatomy of the cerebrum in a
little bit more detail here so that you

0:00:30.359,0:00:34.020
know exactly where things are going on
when we talk about the functions of the

0:00:34.020,0:00:39.210
cerebrum you'll notice that the cerebrum
has lobes and as we said the lobes are

0:00:39.210,0:00:43.350
named according to the skull bones that
they're near so as an example you can

0:00:43.350,0:00:49.890
see here that we have the the frontal
lobe by the frontal bone of course we

0:00:49.890,0:00:53.190
have the parietal lobe which are the
walls of the skull here the parietal

0:00:53.190,0:00:57.960
bones the occipital lobe which is here
the temporal lobe which is here and we

0:00:57.960,0:01:01.649
also have a unique lobe as I mentioned
before which is called the insula which

0:01:01.649,0:01:05.580
is in here and the insula as I said
we're not going to really cover in a

0:01:05.580,0:01:09.840
great amount of detail this is really
for sensation of taste and some other

0:01:09.840,0:01:13.830
things we even mention it again when we
come to these senses at the end of the

0:01:13.830,0:01:16.680
course but for now which is really going
to talk about the frontal parietal

0:01:16.680,0:01:23.100
occipital and temporal lobes so if you
notice you can see that the frontal lobe

0:01:23.100,0:01:28.530
which is indicated in this pink color
here is divided from the parietal lobe

0:01:28.530,0:01:33.810
by this very important separation which
is known as the central sulcus and you

0:01:33.810,0:01:37.590
can see that this goes all the way down
here and divides the frontal from the

0:01:37.590,0:01:42.509
parietal lobe the precentral gyrus for
example is the motor cortex or what we

0:01:42.509,0:01:46.470
call the primary motor cortex the post
central gyrus is the primary

0:01:46.470,0:01:50.700
somatosensory or primary sensory cortex
so we're going to come back and talk

0:01:50.700,0:01:54.990
about that a little bit more as we talk
about the functions of the brain now one

0:01:54.990,0:01:59.130
of the things we mentioned before are
the fact that the cortex has these folds

0:01:59.130,0:02:05.399
which increase its surface area and the

bumps on this are known as gyri one of

0:02:05.399,0:02:09.209
them is known as the gyrus and remember
the spaces between the gyri are known as

0:02:09.209,0:02:13.599
sulci one of these is known as a sulcus
the other thing I want you to pay

0:02:13.599,0:02:19.390
attention to here is notice that on the
outside of the brain here we have gray

0:02:19.390,0:02:24.549
matter right the cortex is the gray
matter on the outside here and we call

0:02:24.549,0:02:30.129
this the cerebral cortex below that
you'll see the white matter and the

0:02:30.129,0:02:34.900
white matter contains myelinated axons
of the neurons that come from the cortex

0:02:34.900,0:02:39.280
so what I want you to be aware of is
that when we talk about the cerebral

0:02:39.280,0:02:43.170
cortex we're really talking about the
outer maybe three millimeter thick

0:02:43.170,0:02:47.829
section of the cortex and then
everything below that is the myelinated

0:02:47.829,0:02:52.540
material as you notice on the bottom of
the slide it says that over 85% of the

0:02:52.540,0:02:58.359
brain mass is the cerebrum with about 14
billion multipolar neurons now we talked

0:02:58.359,0:03:03.129
about multipolar remember these have
many dendrites one axon and as we said

0:03:03.129,0:03:07.720
before of course the lobes are named for
the overlying bones okay so what we're

0:03:07.720,0:03:11.790
going to cover now is a little bit more
about the functions of the cerebrum and

0:03:11.790,0:03:16.870
we talked about this earlier and we said
that the cerebrum is really the

0:03:16.870,0:03:21.819
neocortex responsible for more of the
higher-order functions of the brain and

0:03:21.819,0:03:25.299
you see some of those here all of these
are what we would consider higher-order

0:03:25.299,0:03:30.750
functions of the brain interpretation
initiating voluntary movements memory

0:03:30.750,0:03:36.579
storing retrieving reasoning center for
intelligence of personality so many many

0:03:36.579,0:03:41.409
high-level functions and when we talk
about dividing up the cerebrum into

0:03:41.409,0:03:46.510
functional areas we talk about the motor
area which is the frontal cortex in the

0:03:46.510,0:03:51.159
last slide if you remember that was
shown in pink the sensory areas which

0:03:51.159,0:03:56.470
are the parietal occipital and temporal
cortex and then finally the association

0:03:56.470,0:04:00.280
areas of the brain which really include
all of the lobes and I'm going to show

0:04:00.280,0:04:05.440
you why in a little bit but usually with
any lobe of the brain that either sends

0:04:05.440,0:04:10.060
or receives primary signals that is just
nerve impulses there's usually right

0:04:10.060,0:04:15.669
next to it an association area that will

make sense of those impulses coming in

0:04:15.669,0:04:20.769
and these are the perceptions that we
mentioned before so a couple of things

0:04:20.769,0:04:24.940
to keep in mind about the cerebrum and
the cerebral hemispheres each cerebral

0:04:24.940,0:04:28.360
hemisphere receives information from
from and sends information to the

0:04:28.360,0:04:33.160
opposite side of the body you may know
someone or you may have seen that people

0:04:33.160,0:04:38.530
who have strokes and have a deficit of
some sort on one side of the body it's

0:04:38.530,0:04:42.640
actually the opposite side of the brain
that's affected so in other words if

0:04:42.640,0:04:47.050
they have a stroke on the right side of
the brain any deficits they develop will

0:04:47.050,0:04:50.710
be on the left side of the body so this
is because each cerebral hemisphere

0:04:50.710,0:04:54.370
receives information from and sends
information to the opposite side of the

0:04:54.370,0:04:58.150
body and the other thing we'll touch on
in a little bit is that although they

0:04:58.150,0:05:02.110
look symmetrical the cerebral
hemispheres are not entirely equivalent

0:05:02.110,0:05:06.970
in function okay so this is a major
table that I want you to know for the

0:05:06.970,0:05:10.630
exam I know this looks like a lot but
we're going to cover each of these

0:05:10.630,0:05:14.530
primary areas and you notice that what I
want you to know about the parts of the

0:05:14.530,0:05:19.480
brain these little soundbites that I
have over here they're very short and to

0:05:19.480,0:05:23.470
the point there's certainly more things
that each part does than what I have

0:05:23.470,0:05:27.730
listed here in many cases but what I
want you to know for the exam

0:05:27.730,0:05:32.920
are these main functions of each of the
different parts of the brain and I will

0:05:32.920,0:05:37.390
take the exam answers questions from the
text that you see on the right side of

0:05:37.390,0:05:40.930
this table so well though it's a lot of
information it's something that you do

0:05:40.930,0:05:46.060
need to know this really it's the only
way to get to know everything about the

0:05:46.060,0:05:50.320
brain that you need to know in terms of
how it functions okay all right so let's

0:05:50.320,0:05:54.460
start with an overview of the cerebral
cortex and you see here this diagram

0:05:54.460,0:05:59.080
looks a little complicated the numbers
that you see here are called a Brodman

0:05:59.080,0:06:02.500
map we're not even going to worry about
those we're going to primarily be

0:06:02.500,0:06:06.220
concerned with the colors that we see
here that will help us kind of sort

0:06:06.220,0:06:10.540
through these things let's start with

the frontal cortex and if you remember

0:06:10.540,0:06:14.230
we talked about this very important area
called the central sulcus this divides

0:06:14.230,0:06:20.260
the frontal from the parietal so you can
see that here so this would be in the

0:06:20.260,0:06:24.250
frontal this would be in the parietal
cortex and these are divided by the

0:06:24.250,0:06:28.390
central sulcus now you'll also notice
that if we look at all of this which is

0:06:28.390,0:06:31.690
the frontal lobe of the brain you'll see
that there are three different colors

0:06:31.690,0:06:37.570
here and this pink one that you see in
front is really the most evolutionarily

0:06:37.570,0:06:42.670
advanced portion of the brain
this is called the prefrontal cortex and

0:06:42.670,0:06:47.740
as you see this is designed for
high-level type thinking tasks like

0:06:47.740,0:06:51.850
working memory executive area for task
management planning things and then the

0:06:51.850,0:06:56.680
portion that's shown here in orange is
called the premotor cortex and

0:06:56.680,0:07:00.760
basically what this does is since the
entire frontal cortex is devoted to

0:07:00.760,0:07:05.830
motor function this is the lobe that
will actually that will kind of form the

0:07:05.830,0:07:11.170
impulses that need to be sent to muscles
for example to move so this is kind of a

0:07:11.170,0:07:14.650
planning area in the brain but what
happens is the prefrontal cortex plans

0:07:14.650,0:07:18.670
more in advance
sends information to the premotor cortex

0:07:18.670,0:07:22.390
and then the last portion of the cortex
we're going to talk about here is called

0:07:22.390,0:07:27.790
the primary motor cortex and you can see
that just in front of the central sulcus

0:07:27.790,0:07:32.860
so what you see in this red color right
here is actually called the primary

0:07:32.860,0:07:38.470
motor cortex and what this is going to
do is this is going to send signals down

0:07:38.470,0:07:43.390
the spinal cord to the different muscles
so we're going to be looking at this so

0:07:43.390,0:07:47.560
all of this right here is going to send
signals down and eventually these are

0:07:47.560,0:07:52.150
going to go down to the spinal cord and
out this way okay so that's a bit about

0:07:52.150,0:07:57.550
the frontal cortex now you'll notice in
the back we of course have the parietal

0:07:57.550,0:08:02.290
cortex and one of the things you'll
notice is that just behind the central

0:08:02.290,0:08:08.350
sulcus we have this lobe which is known
as the primary somatosensory cortex and

0:08:08.350,0:08:12.460
what happens with this is that nerve
impulses that are coming up from the

0:08:12.460,0:08:18.580
body come up this way and arrived here

first and then as I said before whenever

0:08:18.580,0:08:22.870
we have a primary area we also have
usually associated with it an

0:08:22.870,0:08:27.580
association area that will make sense of
those impulses that are coming in so

0:08:27.580,0:08:31.420
you'll see right next to it this amount
of sensory association cortex which is

0:08:31.420,0:08:35.349
outlined right here and so the impulses
that come in to the primary

0:08:35.349,0:08:40.000
somatosensory cortex will be relayed to
the somatosensory cortex and the

0:08:40.000,0:08:44.650
somatosensory association cortex will
make sense of the incoming impulses and

0:08:44.650,0:08:48.310
then if you look in the back of the
brain here you'll notice that we have a

0:08:48.310,0:08:52.030
visual area of the brain
here in the very very back we have the

0:08:52.030,0:08:57.250
primary visual cortex and of course
these are going to be the impulses that

0:08:57.250,0:09:01.300
come from the retina that is the light
impulses that are coming back through

0:09:01.300,0:09:05.350
the eyes and these are just nerve
impulses we haven't made sense of these

0:09:05.350,0:09:10.090
yet so what will happen is the primary
visual cortex will relay those impulses

0:09:10.090,0:09:15.190
to this next area which is called the
visual association area so the entire

0:09:15.190,0:09:19.000
back portion of the brain is devoted to
vision as you see now we have the same

0:09:19.000,0:09:22.870
situation when we look at the temporal
lobe which we're hearing is based so

0:09:22.870,0:09:28.180
hearing is here and you'll notice that
we have a primary auditory cortex right

0:09:28.180,0:09:33.520
here so the primary auditory cortex you
can see here and these are once again

0:09:33.520,0:09:38.230
just the raw nerve impulses in order to
make sense of those this area is going

0:09:38.230,0:09:42.400
to relay the impulses to the next area
which is called the auditory association

0:09:42.400,0:09:46.990
area and it's here that we make sense of
the impulses that are coming in from the

0:09:46.990,0:09:50.860
auditory area from the ears basically so
I hope you getting a sense now that

0:09:50.860,0:09:56.650
every primary area in the brain is
connected to an association area that

0:09:56.650,0:10:00.670
actually either makes sense of or puts
things into motion so in the case of the

0:10:00.670,0:10:03.790
sensory areas this is going to make
sense of the impulses that are coming in

0:10:03.790,0:10:08.890
in the frontal cortex we have these
several areas working together which we

0:10:08.890,0:10:13.240
could call association areas that are
really formatting the signals that have

0:10:13.240,0:10:18.520
to go to the muscles want you to notice

here the frontal eye field and the

0:10:18.520,0:10:23.380
frontal eye field which is right here is
devoted to movement of the six extrinsic

0:10:23.380,0:10:27.490
muscles that we have around the eye so
here would be the impulses that

0:10:27.490,0:10:31.060
originate that would move the eye to
focus on different things and to look at

0:10:31.060,0:10:35.950
different things below that you'll see
another area called Broca's area and so

0:10:35.950,0:10:40.270
you see this entire structure right here
is called Broca's area this has to do

0:10:40.270,0:10:45.190
mainly with speech it has to do with
more or less planning speech as well as

0:10:45.190,0:10:50.110
moving the muscles that make our speech
intelligible in other words the muscles

0:10:50.110,0:10:54.610
of the lips tongue pharynx they all get
coordinated through Broca's area now on

0:10:54.610,0:10:58.090
the same side of the brain you'll also
notice this dashed area over here and

0:10:58.090,0:11:02.880
this is called Wernicke's area sometimes
known as the Gnostic area

0:11:02.880,0:11:09.150
and this area basically is a general
sensory portion of the brain in other

0:11:09.150,0:11:13.740
words this takes sensory information and
coordinates it all and in fact what you

0:11:13.740,0:11:18.360
see is for the most part Broca's area
which has to do with speech and

0:11:18.360,0:11:22.860
Wernicke's area which has to do with
sensations these are located on the same

0:11:22.860,0:11:26.880
side of the brain typically this is the
left cerebral hemisphere as we're seeing

0:11:26.880,0:11:32.460
here and these two structures basically
will communicate with one another so as

0:11:32.460,0:11:37.320
we're speaking for example we're picking
up the sensations from our hearing from

0:11:37.320,0:11:41.310
the way our lips and tongue is moving
and what this will do is it will kind of

0:11:41.310,0:11:45.240
coordinate and perform a feedback loop
then these are typically located on the

0:11:45.240,0:11:48.860
same side of the brain so these are
unique to the left cerebral hemisphere

0:11:48.860,0:11:53.070
if you remember in the introductory
slides I mentioned that the two cerebral

0:11:53.070,0:11:56.550
hemispheres although they look very
similar they do have some different

0:11:56.550,0:11:59.700
functions and this is one of the things
that I was talking about and we'll see a

0:11:59.700,0:12:04.200
couple of others in a few minutes okay
so those are the major portions of the

0:12:04.200,0:12:09.240
cerebral hemispheres I hope you've got a
sense of how these work together and

0:12:09.240,0:12:14.280
where things come from where they go to
and how we basically interpret all those

0:12:14.280,0:12:20.130
kinds of sensations now one of the thing

I want to mention in terms of the

0:12:20.130,0:12:24.420
cerebral cortex which you see here on
this side the motor cerebral cortex is

0:12:24.420,0:12:29.310
indicated in red the sensory cerebral
cortex is indicated in blue and all the

0:12:29.310,0:12:33.810
stuff down here and here this is all
myelinated matter so we call this white

0:12:33.810,0:12:38.700
matter down here and all the material
that you see up here in blue for example

0:12:38.700,0:12:44.610
this is the gray matter of the cerebral
cortex okay so we call this the cerebral

0:12:44.610,0:12:49.980
cortex just this our door a couple of
millimeters strip of blue material that

0:12:49.980,0:12:53.760
you see here now one of the things
you'll notice is this structure that

0:12:53.760,0:12:59.160
we're looking at here is called a
homunculus so we have a homunculus on

0:12:59.160,0:13:02.760
the left homunculus on the right
literally in Latin this means little man

0:13:02.760,0:13:06.180
and if you look at the top of the slide
you'll notice that we have a view from

0:13:06.180,0:13:10.110
above the brain and this is the anterior
so this is the primary motor cortex

0:13:10.110,0:13:14.190
indicated in red and you see that on the
left of the slide and this is the

0:13:14.190,0:13:19.100
primary sensory or somatosensory
cortex that's located behind the central

0:13:19.100,0:13:23.570
sulcus and notice that they're on both
sides of the brain as we mentioned

0:13:23.570,0:13:27.410
before if we think about the motor
cortex

0:13:27.410,0:13:30.830
remember this is sending commands to the
opposite side so it makes sense that

0:13:30.830,0:13:33.800
we'd have one on each side of the brain
right one in each cerebral hemisphere

0:13:33.800,0:13:37.910
now you'll notice that this homunculus
that we're talking about or this little

0:13:37.910,0:13:43.010
man is kind of out of proportion and one
of the reasons for that is what this

0:13:43.010,0:13:47.930
homunculus diagram shows is how many
neurons in the cerebral cortex are

0:13:47.930,0:13:53.600
devoted to a particular function now if
you look at for example the trunk legs

0:13:53.600,0:13:58.130
feet all of these motor functions are
occupied by this relatively small

0:13:58.130,0:14:02.390
section of the motor cortex whereas if
you take a look at the hand that

0:14:02.390,0:14:07.990
occupies just about as much as all of
the back.the but the thighs the feet and

0:14:07.990,0:14:12.530
because we have to have so many fine
movements of the hand we need a lot more

0:14:12.530,0:14:16.790
neurons to do that there are a lot more
muscles that have to be finely

0:14:16.790,0:14:21.200
controlled so we need a lot more neurons

coming from the cerebral cortex you'll

0:14:21.200,0:14:24.950
also notice the face right all the
muscles that we have in the face for

0:14:24.950,0:14:30.500
example many many muscles that have to
be controlled by a lot of gray matter in

0:14:30.500,0:14:34.520
the cerebral cortex so a lot of neurons
devoted to that and you also know the

0:14:34.520,0:14:38.870
tongue has its own section here so we
control the tongue really very finely

0:14:38.870,0:14:43.220
when we speak for example processing
food now if you look on the

0:14:43.220,0:14:47.270
somatosensory side on the sensory cortex
on the right you notice we have a very

0:14:47.270,0:14:51.410
similar diagram the only thing that we
see that's a little bit different is

0:14:51.410,0:14:56.390
down here because we have some sensory
organs here for example we have the

0:14:56.390,0:15:00.050
teeth gums jaw these are receiving
sensory impulses the tongue also

0:15:00.050,0:15:04.910
receiving sensory impulses the abdominal
organs that you see here so we don't

0:15:04.910,0:15:08.240
have those on the right because we have
other motor centers that deal with those

0:15:08.240,0:15:11.840
but this is the sensory information and
over here you actually see I forgot this

0:15:11.840,0:15:16.130
one you see the genitals over here and
you see that there's a whole section of

0:15:16.130,0:15:20.960
the sensory cortex that's devoted to
those as well now this is where I was

0:15:20.960,0:15:24.350
talking about before that the two
cerebral hemispheres are different in

0:15:24.350,0:15:28.760
terms of what they do remember before we
talked about the speech Center I hope

0:15:28.760,0:15:32.100
you remember with that
right that's called Broca's area and

0:15:32.100,0:15:35.759
then we have the general interpretive
center of the brain over here which is

0:15:35.759,0:15:39.899
called Wernicke's area and remember as
we said typically these are located on

0:15:39.899,0:15:44.399
the left cerebral cortex and these two
areas talk to one another eyes you'll

0:15:44.399,0:15:48.269
also notice a couple of other things
here that are a little bit different

0:15:48.269,0:15:52.079
over on the right side of the brain for
example you'll notice that we have this

0:15:52.079,0:15:58.019
spatial visualization center to the
brain and in general we can say that the

0:15:58.019,0:16:01.980
left side of the brain that is the left
cerebral hemisphere is called the

0:16:01.980,0:16:07.290
categorical hemisphere I always like to
think of this as the logical side of the

0:16:07.290,0:16:12.389
brain so think left logical this has to
do with more linear processing of things

0:16:12.389,0:16:17.759
like writing like mathematics like

science where we use logic from one step

0:16:17.759,0:16:22.109
to another whereas the right side of the brain is the representational hemisphere

0:16:22.109,0:16:26.850
and you can kind of think of this as the artsy fartsy side of the brain and I

0:16:26.850,0:16:31.410
don't mean to criticize artists and people who are very good with colors and

0:16:31.410,0:16:35.730
shapes and that sort of thing but it's a good way to remember so the right is the

0:16:35.730,0:16:40.559
artsy fartsy the left is the logical side of the brain so you can see that

0:16:40.559,0:16:44.639
these two cerebral hemispheres actually do different things do they communicate

0:16:44.639,0:16:49.679
with one another sure if you remember we mentioned this corpus callosum when we

0:16:49.679,0:16:53.249
talked about the longitudinal fissure and what's below it the corpus callosum

0:16:53.249,0:16:58.439
is this thick band of neural tissue that connects both sides of the cerebrum and

0:16:58.439,0:17:03.179
very importantly these two sides have to communicate with one another where the

0:17:03.179,0:17:08.279
person basically is either very very logical that is too logical or very very

0:17:08.279,0:17:12.539
emotional - emotional without much logic input and there are cases where the

0:17:12.539,0:17:16.319
corpus callosum has been severed or because of certain diseases that they

0:17:16.319,0:17:20.159
don't communicate with the two cerebral
hemispheres don't communicate well with

0:17:20.159,0:17:25.079
each other and this really does cause a
problem so integrating both cerebral

0:17:25.079,0:17:29.220
hemispheres is very very important for
us now you may have heard the term left

0:17:29.220,0:17:35.419
brain right brain and it just means that
most of us have a dominant hemisphere

0:17:35.419,0:17:40.110
some of us are more associated with the
left categorical hemisphere so we're

0:17:40.110,0:17:44.399
more logical
and then some of us are more more

0:17:44.399,0:17:49.799
attuned to colors and emotions shapes
and that sort of thing and we would be

0:17:49.799,0:17:54.960
representational hemisphere dominant so
a right-side dominant of the brain so

0:17:54.960,0:17:59.340
this is just a little bit of an example
of the different functions of the

0:17:59.340,0:18:03.510
cerebral hemispheres and this is known
as hemispheric or cerebral

0:18:03.510,0:18:08.100
lateralization just means that two
cerebral hemispheres function slightly

0:18:08.100,0:18:11.100
differently now when we go down in the
brain a little bit you'll notice once

0:18:11.100,0:18:15.720
again the gray material up here is the
cerebral cortex and remember this is the

0:18:15.720,0:18:20.250
outer couple of millimeters of the

cerebrum and this is what we call the

0:18:20.250,0:18:24.389
cerebral cortex below that we see all
this white matter down here which are

0:18:24.389,0:18:28.980
myelinated neurons myelinated axons of
the neurons that are coming down from

0:18:28.980,0:18:32.429
the cerebral cortex and then if you
notice what we're going to talk about

0:18:32.429,0:18:37.620
now are these kind of islands of gray
matter within the white matter that's

0:18:37.620,0:18:42.990
deep in the brain and these are called
the basal nuclei these were formally

0:18:42.990,0:18:46.320
called the basal ganglia but ganglia
actually means something different in

0:18:46.320,0:18:50.389
terms of the nervous system so more
properly these are called basal nuclei a

0:18:50.389,0:18:55.289
nucleus is just a mass of gray matter in
the central nervous system and you can

0:18:55.289,0:18:58.919
see that definition right here which is
why we call these basal nuclei because

0:18:58.919,0:19:03.299
all of these are masses of gray matter
way down deep in the brain now we have a

0:19:03.299,0:19:07.799
few different nuclei here you can notice
that we have a caudate nucleus putamen

0:19:07.799,0:19:13.529
globus pallidus and importantly what I
want you to realize about these is that

0:19:13.529,0:19:18.450
these function in subconscious control
of certain muscular activities that is

0:19:18.450,0:19:23.399
like learned movement patterns you know
when we're when we're walking we're

0:19:23.399,0:19:27.720
doing repetitive type things we
basically will send signals from the

0:19:27.720,0:19:33.389
motor cortex down this way and these
pieces of gray matter will actually send

0:19:33.389,0:19:38.519
output back up and so we have kind of a
reverberation sequence over here and

0:19:38.519,0:19:43.590
then finally these will eventually send
signals down the spinal cord to move the

0:19:43.590,0:19:47.850
appropriate muscles but as we're moving
the muscles once again we get a feedback

0:19:47.850,0:19:53.370
loop and so we can develop more fine
control of muscles and especially those

0:19:53.370,0:19:56.919
that have learned
movement patterns and this is down here

0:19:56.919,0:20:00.340
you can see in the lower right that as I
said these receive input from the

0:20:00.340,0:20:05.019
cerebral cortex and they relay motor
impulses originating in this region

0:20:05.019,0:20:11.470
called the substantia nigra along with
their own output so these are important

0:20:11.470,0:20:18.340
areas in the brain as well we have as I
said down below the cortex all of this

0:20:18.340,0:20:22.450
white matter and you can see that it's
all white down here so all of this is

0:20:22.450,0:20:27.370
white matter the cerebral cortex is up

here this is the gray matter and we

0:20:27.370,0:20:32.919
actually have three different kinds of
tracts of white matter and these tracts

0:20:32.919,0:20:39.279
are called sssociation tracts commisural tracts and projection tracts now
the difference

0:20:39.279,0:20:44.919
between these is that association tracts
are basically in the same hemisphere so

0:20:44.919,0:20:49.090
as an example you can see the
association fibers that are here and all

0:20:49.090,0:20:53.080
of these pink kind of structures are
located in the same cerebral hemispheres

0:20:53.080,0:20:57.730
so we always have association fibers
located in the left or the right but

0:20:57.730,0:21:02.529
they don't cross over the commisural tracts
however our fibers or tracts that

0:21:02.529,0:21:07.899
actually cross over to the other side
and our primary example of a commisural

0:21:07.899,0:21:11.470
type tract will be the corpus callosum
that we saw just a couple of minutes ago

0:21:11.470,0:21:15.639
that connects the two sides of the
cerebral hemispheres and finally we have

0:21:15.639,0:21:20.049
projection tracts and the projection
tracts are the ones that go up and down

0:21:20.049,0:21:24.820
from the brain down to the spinal cord
back up and these are projection fibers

0:21:24.820,0:21:29.919
that you see here these are indicated in
blue in the diagram that's here and you

0:21:29.919,0:21:33.190
can see some of these other things here
this is a side view of all these

0:21:33.190,0:21:38.169
different kind of fibers association
commisural projection fibers so really

0:21:38.169,0:21:41.379
what I want you to know about these is
basically where they connect so

0:21:41.379,0:21:46.090
association same hemisphere commisural
they connect opposite hemispheres

0:21:46.090,0:21:50.740
projection tracts are the a sending and
descending tracts now we're going to

0:21:50.740,0:21:55.149
talk about this a little bit later but
when we refer to a tract we're talking

0:21:55.149,0:22:00.340
about a section of myelinated or white
matter that basically contains the same

0:22:00.340,0:22:04.419
type of axons that is axons that
originate and terminate in the same

0:22:04.419,0:22:07.630
place and that's what we call a tract
and we're going to come back to that

0:22:07.630,0:22:11.950
a little while later when we talk about
the peripheral nervous system and more

0:22:11.950,0:22:15.790
of the central nervous system now one of
the other things we want to talk about

0:22:15.790,0:22:20.380
here is called the limbic system the
reason we call this a system is because

0:22:20.380,0:22:24.910
you'll notice it takes into and
encompasses lots of different areas in

0:22:24.910,0:22:29.740
the brain so this is not made up of one

particular area in the brain but as you

0:22:29.740,0:22:33.790
can see here with all these descriptions
it's made of many many sites in the

0:22:33.790,0:22:37.780
brain and this is an important area
because one of the things it does is

0:22:37.780,0:22:41.770
it's a one of our main centers for
control of emotions as you see on the

0:22:41.770,0:22:46.510
bottom left so it produces feelings
controls emotions interpret sensory

0:22:46.510,0:22:51.520
impulses in the sense that it helps us
to associate sensory impulses with

0:22:51.520,0:22:57.190
memories for example it also facilitates
memory storage and retrieval the memory

0:22:57.190,0:23:01.810
storage and retrieval primarily is
associated with the hippocampus and this

0:23:01.810,0:23:05.890
is kind of unusual because unlike most
neurons in the brain it's believed that

0:23:05.890,0:23:10.390
the hippocampal neurons can actually
regenerate and that's not something that

0:23:10.390,0:23:14.350
the rest of the nervous system can do
because the nerves are basically fully

0:23:14.350,0:23:18.610
differentiated and then you'll also
notice another area that's called the

0:23:18.610,0:23:23.500
amygdala the amygdala is typically
associated with rage aggression they've

0:23:23.500,0:23:26.560
done several experiments where they can
actually stimulate electrically the

0:23:26.560,0:23:32.170
amygdala and they can produce feelings
of rage and aggression and so you can

0:23:32.170,0:23:35.440
see all these what I really want you to
remember about these are the functions

0:23:35.440,0:23:40.150
of the limbic system which are down on
the lower left here this is also called

0:23:40.150,0:23:44.770
the motivational system in other words
when we want to do something if you

0:23:44.770,0:23:48.190
think about that that's really an
emotion you know we have an emotional

0:23:48.190,0:23:52.240
attachment to getting something done and
since that's one of the emotions that

0:23:52.240,0:23:56.650
the limbic system deals with this is
really a major site of what we call the

0:23:56.650,0:24:00.700
motivational system now the last thing
we want to talk about in this lecture is

0:24:00.700,0:24:05.800
about memory and as you see on top the
definition of a memory is persistence of

0:24:05.800,0:24:11.410
knowledge that we can access at a later
time we hope so anyway right and one of

0:24:11.410,0:24:15.100
the things I want to mention is that
memories unlike what you may think are

0:24:15.100,0:24:19.930
not stored in individual memory cells or
neurons so it's not just one neuron

0:24:19.930,0:24:23.559
rather it's a whole
pathway and these pathways are known as

0:24:23.559,0:24:28.840
engrams these are memory traces the way

that these memory traces are made is

0:24:28.840,0:24:33.220
that certain synapses between the
neurons are strengthened and then with

0:24:33.220,0:24:38.770
disuse some of them kind of fall away so
the more you repeat something as you

0:24:38.770,0:24:43.570
probably know the stronger that memory
becomes and this is all because of

0:24:43.570,0:24:47.799
synapses between the neurons now we have
several different kinds of memory that I

0:24:47.799,0:24:52.240
want to talk about for the exam
remembering the items that I have here

0:24:52.240,0:24:56.710
in terms of examples I think will help
you remember these immediate memory is

0:24:56.710,0:25:01.210
the first one and this type of memory
only lasts a few seconds so as an

0:25:01.210,0:25:05.200
example I have here if you're reading a
long sentence or even just a short

0:25:05.200,0:25:09.130
sentence when you get to the period at
the end you have to know what you read

0:25:09.130,0:25:11.590
in the beginning of the sentence
otherwise you'd be reading the same

0:25:11.590,0:25:15.490
thing over and over and over the type of
memory that holds the beginning portion

0:25:15.490,0:25:20.950
of that sentence in memory until you get
to the end is called immediate memory so

0:25:20.950,0:25:25.210
this is a very very short type of memory
the second kind of memory that we have

0:25:25.210,0:25:30.580
is called short-term memory this lasts a
few seconds to a few hours depending on

0:25:30.580,0:25:34.149
what you're doing a good example of this
is when we use phone books which we

0:25:34.149,0:25:38.080
don't need more I guess we used to look
up a telephone number you know go to the

0:25:38.080,0:25:43.240
phone dial the number and it was busy so
what we used to do is keep repeating the

0:25:43.240,0:25:47.350
number over and over and over and what
we were doing by repeating that right

0:25:47.350,0:25:52.179
away was rehearsing it in short-term
memory and of course once we got through

0:25:52.179,0:25:56.020
to the number more than likely a few
hours later we would completely forget

0:25:56.020,0:26:00.850
that number again so short-term memory
is volatile it's kind of like the RAM

0:26:00.850,0:26:05.200
and a computer it'll stay there as long
as we're using it and then once we're

0:26:05.200,0:26:10.480
done using it that kind of goes away if
you notice down the bottom we have this

0:26:10.480,0:26:14.770
working memory which is a form of the
short-term memory and this is the

0:26:14.770,0:26:18.730
example that I just used of dialing a
number over and over now short-term

0:26:18.730,0:26:23.140
memory is limited to what we call a few
bits of information and a bit would be

0:26:23.140,0:26:29.110
one particular thing like a letter a

number an item and usually we're limited

0:26:29.110,0:26:33.130
to about seven to nine bits of
information at any one time what I have

0:26:33.130,0:26:37.010
here is this phrase
and I'll explain what I mean by that

0:26:37.010,0:26:41.690
let's just say for example that we're
looking at a phone number and the phone

0:26:41.690,0:26:49.370
number is area code three six zero three
one four that's the first portion of it

0:26:49.370,0:26:56.270
and one four nine two okay that's just a
random phone number and what you can see

0:26:56.270,0:27:00.830
here is that if you just tried to
memorize the phone number or tried to

0:27:00.830,0:27:04.390
keep this in short-term memory you may
have to keep repeating it over and over

0:27:04.390,0:27:09.770
however there's a way to reduce the
number of bits from if you notice one

0:27:09.770,0:27:14.990
two three four five six seven eight nine
ten this is ten bits of information a

0:27:14.990,0:27:19.250
little bit longer than the maximum of
nine that most of us have but we can

0:27:19.250,0:27:24.020
reduce this actually to three bits of
information so how do we do that well

0:27:24.020,0:27:27.560
notice the three six zero one good way
remembering this is the number of

0:27:27.560,0:27:32.690
degrees in a circle right that's three
six zero three one four if you're

0:27:32.690,0:27:36.290
mathematically inclined you can remember
that this is the first three digits of

0:27:36.290,0:27:40.280
pi and then one four nine two you can
remember

0:27:40.280,0:27:48.260
Columbus crossed the ocean blue in 1492
so circle pi Columbus if you remember

0:27:48.260,0:27:53.480
those three things you've reduced this
ten bit information into three bits of

0:27:53.480,0:27:58.250
information that you can remember one
fact each and this is a great way for

0:27:58.250,0:28:02.960
you to do this kind of stuff with
anatomy and physiology when you're

0:28:02.960,0:28:07.520
memorizing things for exam try and chunk
those things so that you can remember

0:28:07.520,0:28:12.410
them a little bit more easily and that
one chunk of information should remind

0:28:12.410,0:28:16.670
you of the individual things that it's
made up of so this chunking is very very

0:28:16.670,0:28:23.030
important in studying and it really will
help you to remember more things in an

0:28:23.030,0:28:27.440
easier way now the last kind of memory
we have down here of course is long term

0:28:27.440,0:28:31.880
memory this is memory that can last a
lifetime and it usually does we don't

0:28:31.880,0:28:35.870
really forget too many things in other
words that Engram or memory trace is

0:28:35.870,0:28:40.700
usually there all the time the only

problem is that we can't retrieve it

0:28:40.700,0:28:45.590
because the synapses are kind of gone
away a little bit and so if we don't use

0:28:45.590,0:28:49.670
something for a long period of time
typically we seem to have forgotten it

0:28:49.670,0:28:53.930
because we can't retrieve it in fact the
memory trace is there and if we were to

0:28:53.930,0:28:57.860
review the information a little bit that
memory trace would be reactivated the

0:28:57.860,0:29:02.780
synapse will be strengthened and the
memory would be more available to us now

0:29:02.780,0:29:07.000
you can notice that we have a couple of
kinds of memory long-term memory

0:29:07.000,0:29:11.720
declarative and we also have this
procedural declarative as you see is for

0:29:11.720,0:29:14.810
events in facts
procedural knowledge is more for motor

0:29:14.810,0:29:18.410
skills and of course long-term memory as
it says here can hold much more

0:29:18.410,0:29:23.540
information than the short-term memory
and in fact what has to happen in order

0:29:23.540,0:29:27.770
for us to create a long-term memory is
we somehow have to transfer short-term

0:29:27.770,0:29:32.030
memory to long-term memory and if you
remember one of the regions of the brain

0:29:32.030,0:29:36.800
that I talked about in the limbic system
was the hippocampus the hippocampus is

0:29:36.800,0:29:40.640
believed to be associated with the
short-term memory transferring into

0:29:40.640,0:29:45.920
long-term memory up into the cerebral
cortex so it's fortunate that that area

0:29:45.920,0:29:50.690
they think anyway can regenerate neurons
because this has to do with memory so

0:29:50.690,0:29:57.610
that will finish part 3 of lecture 19 I
will see you in the next part