Bio101 Lecture 19 CNS – Part 5

0:00:00.030,0:00:03.510
welcome to the last part of lecture 19
this is part five we're going to talk

0:00:03.510,0:00:09.690
about the spinal cord which is the other
part of the central nervous system as an

0:00:09.690,0:00:13.500
overview of the spinal cord you can see
that the spinal cord extends from the

0:00:13.500,0:00:17.160
foramen magnum of the skull as we talked
about when we talked about the brainstem

0:00:17.160,0:00:21.840
to the second lumbar vertebra so
obviously from laboratory you know that

0:00:21.840,0:00:25.500
there are more vertebra inferior to the
second lumbar vertebra so the spinal

0:00:25.500,0:00:30.090
cord actually stops before the end of
the vertebral column so here we're

0:00:30.090,0:00:34.590
looking at the end of what essentially
is the meaty part of the spinal cord and

0:00:34.590,0:00:39.210
this is around L2 you'll notice after
that what happens is nerves come down

0:00:39.210,0:00:43.829
here and so all this space that's down
here are basically nerves that are

0:00:43.829,0:00:47.520
coming from the spinal cord this is not
actually the meaty portion of the spinal

0:00:47.520,0:00:50.309
cord
this looks like a horse's tail so this

0:00:50.309,0:00:54.930
is called a cauda equina and in Latin of
course this means horse's tail you

0:00:54.930,0:00:58.530
notice where the spinal cord ends this
is referred to as the medullary cone

0:00:58.530,0:01:02.280
sometimes you may see this as two conus
medullaris which is what this is an

0:01:02.280,0:01:06.990
Latin and this area down here in the
cauda equina is useful for lumbar

0:01:06.990,0:01:11.280
puncture as you see over here what
happens is if a needle is put in here

0:01:11.280,0:01:15.689
these fibers basically will separate
kind of like the beads on a

0:01:15.689,0:01:19.619
beaded door and they'll come back
together again so there's no risk of

0:01:19.619,0:01:23.549
injury to the actual spinal cord itself
you'll see some of these other features

0:01:23.549,0:01:27.509
of the spinal cord up in the top portion
of the spinal cord there's a cervical

0:01:27.509,0:01:32.130
enlargement there's also a lumbar
enlargement and these areas of

0:01:32.130,0:01:35.400
enlargement are areas where there are
more nerves that need to come out from

0:01:35.400,0:01:39.360
the spinal cord there also is at the
bottom a something called a terminal

0:01:39.360,0:01:44.040
filum and this is basically a
connection down to the lowest portion of

0:01:44.040,0:01:48.299
the vertebral column down to the coccyx
you can also see on the right how the

0:01:48.299,0:01:52.290
individual nerves that come out of the

meaty portion of the spinal cord here

0:01:52.290,0:01:57.299
actually form nerves there are rootlets
that come out and these all unite in a

0:01:57.299,0:02:00.149
spinal nerve which we're going to talk
about in a little while we'll define

0:02:00.149,0:02:05.850
what a spinal nerve is and what forms
that now if we look at the meninges of

0:02:05.850,0:02:09.330
the spinal cord they're very similar to
the meninges we talked about with the

0:02:09.330,0:02:13.510
cerebrum if you remember there were
three meninges there was a dura on the

0:02:13.510,0:02:18.220
portion on arachnoid in the middle and a
pia mater on the inside we have the same

0:02:18.220,0:02:22.959
three layers in the spinal cord if you
look on the upper left of this image

0:02:22.959,0:02:26.980
you'll see meningess here so we
have the dura which is shown in brown

0:02:26.980,0:02:30.970
here this is the outer tough layer the
arachnoid which is the middle layer and

0:02:30.970,0:02:34.930
finally the pia which is a very delicate
layer that's adherent to the meet of the

0:02:34.930,0:02:38.829
spinal cord itself now as we talked
about before remember that cerebrospinal

0:02:38.829,0:02:43.060
fluid will flow in the subarachnoid
space the same is true of the spinal

0:02:43.060,0:02:46.209
cord and here you can see a
cross-section of the spinal cord we're

0:02:46.209,0:02:49.690
going to talk about this which is called
the gray matter of the spinal cord that

0:02:49.690,0:02:53.440
little butterfly shaped region there and
we're going to go into some more detail

0:02:53.440,0:02:57.430
about that in a little while there's one
thing that's different between the

0:02:57.430,0:03:01.540
spinal cord versus how the brain sits in
the skull one of the things we talked

0:03:01.540,0:03:04.299
about if you remember when we talked
about the cerebrum we talked about

0:03:04.299,0:03:09.370
meninges that surrounded was the fact
that the dua was adherent to the

0:03:09.370,0:03:13.720
periosteal layer of the skull bone so
that outer dura if you remember in the

0:03:13.720,0:03:17.590
spinal cord however there's actually a
space as you see here between the bone

0:03:17.590,0:03:21.579
of the vertebra and the dura of the
spinal cord which I'm tracing in red

0:03:21.579,0:03:26.139
here this area right in here is
something that's known as an epidural

0:03:26.139,0:03:30.970
space you may have heard of an epidural
anesthetic this is where an anesthetic

0:03:30.970,0:03:35.349
is injected in here and by gravity this
will flow down to lower levels of the

0:03:35.349,0:03:39.699
spinal cord and basically numb from
wherever it's injected down and this is

0:03:39.699,0:03:43.959
called an epidural there also are some

very fine what we call denticulate

0:03:43.959,0:03:48.849
ligaments that actually will attach the
spinal cord over here and you can see

0:03:48.849,0:03:52.269
these denticulate ligaments over here
these are very fine ligaments that

0:03:52.269,0:03:57.010
basically will anchor the spinal cord
inside the vertebral foramen now let's

0:03:57.010,0:04:00.730
take a look at the organization of the
spinal gray matter as I mentioned the

0:04:00.730,0:04:04.629
gray matter is this butterfly shaped
region that I'm tracing out right here

0:04:04.629,0:04:09.159
so everything you see that's inside what
I'm tracing out is what's called the

0:04:09.159,0:04:13.000
spinal gray matter and the gray matter
of the spinal cord is not just

0:04:13.000,0:04:17.459
haphazardly laid out in other words the
gray matter remember our unmyelinated

0:04:17.459,0:04:22.180
axons so the cell bodies and
unmyelinated axons that make up this

0:04:22.180,0:04:25.750
gray matter are arranged in certain
areas and that's really what we want to

0:04:25.750,0:04:29.020
talk about here you'll notice
the butterfly-shaped region itself

0:04:29.020,0:04:33.850
divides the spinal cord neatly into
several regions this region over here is

0:04:33.850,0:04:38.740
the lateral side this region over here
is another lateral side here would be

0:04:38.740,0:04:43.030
the anterior portion and here would be
the posterior portion of the spinal cord

0:04:43.030,0:04:47.740
so basically the spinal gray matter
divides the spinal cord into these four

0:04:47.740,0:04:50.680
sections and we're going to come back
and we're going to talk about these

0:04:50.680,0:04:55.540
areas out here which are actually white
matter that is myelinated axons you'll

0:04:55.540,0:04:59.560
also notice that in the very center of
the spinal cord we have this central

0:04:59.560,0:05:03.220
canal and as we talked about when we
talked about cerebrospinal fluid the

0:05:03.220,0:05:06.639
cerebrospinal fluid flows down the
central canal in addition to flowing

0:05:06.639,0:05:10.570
through the subarachnoid space in the
spinal cord okay so let's take a look at

0:05:10.570,0:05:15.370
the organization of areas in the spinal
gray matter first of all you notice in

0:05:15.370,0:05:19.479
the front most portion here the anterior
most portion is what's called the

0:05:19.479,0:05:23.800
somatic motor area we can think of
somatic and I think I mentioned this

0:05:23.800,0:05:27.729
when we talked about the orientation to
the spinal cord we can think of somatic

0:05:27.729,0:05:35.229
as applying to skin bones muscles and
articulations so the first four letters

0:05:35.229,0:05:41.289
in somatic will basically tell us what

these nerves control so this is the s-o-m-a

0:05:41.289,0:05:46.840
of somatic so skin bones muscles and
articulations this is what the somatic

0:05:46.840,0:05:51.310
motor system deals with I like to think
of these things as the hard things in

0:05:51.310,0:05:54.520
the body as opposed to visceral which
we'll talk about in a minute which I

0:05:54.520,0:05:57.639
refer to as squishy
just a good term to remember them by so

0:05:57.639,0:06:00.370
let's take a look once again at the
front portion of the spinal cord

0:06:00.370,0:06:04.750
everything that you see here in orange
is an area that houses somatic motor

0:06:04.750,0:06:09.880
neurons these axons from the somatic
motor neurons exit through what's called

0:06:09.880,0:06:14.229
the ventral root remember ventral same
thing as interior now going to the very

0:06:14.229,0:06:17.620
back of the spinal cord you'll notice
that we have an area that's called

0:06:17.620,0:06:22.240
somatic sensory so once again there's
that word somatic and we know what kind

0:06:22.240,0:06:27.940
of things these deal with skin bones
muscles articulations these are incoming

0:06:27.940,0:06:32.560
sensory impulses and they're coming
through the dorsal root as you see here

0:06:32.560,0:06:35.680
we're going to talk about that a little
bit later but notice that the somatic

0:06:35.680,0:06:39.640
portions of the spinal gray matter are
all the way in the back and all the way

0:06:39.640,0:06:43.180
in the front now in between the
somatic portions we have here the

0:06:43.180,0:06:47.320
visceral and you'll see the terms for
these on the outside we have visceral

0:06:47.320,0:06:52.150
sensory visceral motor the visceral
motor is closest to the somatic motor

0:06:52.150,0:06:55.990
region so that is right here and as I
mentioned a second ago visceral deals

0:06:55.990,0:06:59.230
with the more squishy things in the body
as opposed to those hard things like

0:06:59.230,0:07:03.370
bones skin muscles and you'll notice at
the back portion here that's indicated

0:07:03.370,0:07:07.990
in this kind of light pink color this is
a visceral sensory area so we have input

0:07:07.990,0:07:13.150
coming from all of the things that we
deal with that we think of somatic right

0:07:13.150,0:07:18.220
like bones muscles those kind of things
except now we have fibers coming from

0:07:18.220,0:07:23.470
viscera so in essence what we have here
is in the back we have visceral sensory

0:07:23.470,0:07:28.390
neurons in other words these are
relaying inputs from viscera that is

0:07:28.390,0:07:32.500
these are sensory inputs from different
organs in the body and then we also have

0:07:32.500,0:07:36.970
visceral motor and we have outputs that

come from here and these will also go

0:07:36.970,0:07:40.630
out the ventral root and they will wind
up going to the squishy things in the

0:07:40.630,0:07:45.040
body here we're talking about smooth
muscle glands cardiac muscle those sort

0:07:45.040,0:07:48.010
of things so for the exam you should
know the different regions of the spinal

0:07:48.010,0:07:52.900
gray matter and you should also be able
to tell which particular organs or

0:07:52.900,0:07:56.770
structures in the body each region
controls now if you look at the diagram

0:07:56.770,0:08:00.550
here we can actually take a look at the
spinal cord and some of the nerve roots

0:08:00.550,0:08:04.120
there are some terms that I want you to
know here and if you look down the

0:08:04.120,0:08:07.450
bottom these are some of the terms that
I want you to know let's take a look at

0:08:07.450,0:08:09.640
this
here once again we have the same layout

0:08:09.640,0:08:14.040
of the spinal gray matter we saw before
here's the somatic motor visceral motor

0:08:14.040,0:08:19.030
visceral sensory and somatic sensory
you'll notice that axons that come out

0:08:19.030,0:08:23.590
of each of these areas in particular the
somatic motor and visceral motor come

0:08:23.590,0:08:27.760
out what's called the ventral root as I
mentioned before and the neurons that

0:08:27.760,0:08:32.110
are coming into the visceral sensory and
somatic sensory regions come in through

0:08:32.110,0:08:35.800
the dorsal root now one of the things
about this is you'll notice that we have

0:08:35.800,0:08:42.099
cell bodies of somatic motor neurons in
the ventral horn right here however in

0:08:42.099,0:08:46.510
the back it's a little bit different the
cell bodies of somatic sensory neurons

0:08:46.510,0:08:51.580
and visceral sensory neurons are housed
outside the spinal cord and when we have

0:08:51.580,0:08:54.980
a group of neurons that are outside the
central nervous

0:08:54.980,0:09:00.589
them we refer to these as ganglia so
what we call this swelling in the root

0:09:00.589,0:09:06.110
right here is the dorsal root ganglion
and what it houses is the cell bodies of

0:09:06.110,0:09:10.459
sensory neurons so that's a little bit
of a difference between how the neurons

0:09:10.459,0:09:15.050
and axons come into and out of the
anterior and the posterior portions of

0:09:15.050,0:09:18.050
the spinal gray matter so let's take a
look at some of these terms that I want

0:09:18.050,0:09:22.010
you to know and be able to label on a
diagram of the spinal cord like this

0:09:22.010,0:09:25.850
first of all in the front here we have
coming out of the anterior horn or

0:09:25.850,0:09:30.800
ventral horn this whole structure right

here is known as the ventral root so

0:09:30.800,0:09:34.430
this is motor obviously because remember
we have somatic motor and visceral motor

0:09:34.430,0:09:38.839
fibers coming out here so this is the
ventral root in the back we have a

0:09:38.839,0:09:43.399
dorsal root this is sensory remember we
have visceral sensory somatic sensory

0:09:43.399,0:09:47.149
neurons coming in and so this back
portion that you see right here is

0:09:47.149,0:09:51.290
referred to as the dorsal root and then
as we talked about a second ago we have

0:09:51.290,0:09:55.459
a dorsal root ganglion which houses the
cell bodies of sensory neurons and now

0:09:55.459,0:09:59.750
notice that these come together they
come together right here and here we

0:09:59.750,0:10:04.430
have what we call a spinal nerve this is
what actually is going to exit through

0:10:04.430,0:10:09.740
the intervertebral foramina the spinal
nerve is basically a mixed nerve that is

0:10:09.740,0:10:15.199
it's carrying both motor information out
and sensory information in so we call

0:10:15.199,0:10:19.550
that a mixed nerve and it's formed by
the union of the ventral and the dorsal

0:10:19.550,0:10:22.790
roots
okay so let's next look at the

0:10:22.790,0:10:26.360
organization of the spinal white matter
now as I mentioned before when we talked

0:10:26.360,0:10:30.079
about the gray matter we talked about
the fact that the gray matter divides

0:10:30.079,0:10:35.540
the spinal cord on the outside into
these two lateral portions a posterior

0:10:35.540,0:10:41.180
portion and an anterior portion so as we
said this butterfly shaped region of

0:10:41.180,0:10:45.290
spinal gray matter divides up the white
matter in the spinal cord and each one

0:10:45.290,0:10:50.180
of these has a particular name this area
that's on the lateral side here and the

0:10:50.180,0:10:54.889
lateral side over here both of these are
referred to as lateral white columns now

0:10:54.889,0:10:59.149
in cross-section this might look like a
just a kind of two-dimensional flat

0:10:59.149,0:11:02.660
surface but remember that the spinal
cord runs in three dimensions on the

0:11:02.660,0:11:06.290
right side I'm going to draw the spinal
cord going down here remember what we're

0:11:06.290,0:11:10.160
looking at is just a section through
so what more or less looks like a flat

0:11:10.160,0:11:15.170
planar section but in fact this lateral
portion would be like this so in other

0:11:15.170,0:11:19.100
words it would form a column this is the
reason why we call it the lateral white

0:11:19.100,0:11:23.570
column and in the back we have this
whole region back here which is referred

0:11:23.570,0:11:27.800
to as the posterior white column on the

other side of course we'd have another

0:11:27.800,0:11:31.880
lateral white column and then in the
anterior portion notice that we have the

0:11:31.880,0:11:36.890
anterior white column which is all of
this area that's in here okay so for

0:11:36.890,0:11:40.130
different areas now these areas are
going to become important because we're

0:11:40.130,0:11:44.240
going to talk in a second about the
axons of myelinated nerves that are

0:11:44.240,0:11:48.170
grouped together in terms of function
and we're going to talk about these

0:11:48.170,0:11:53.810
things that are called tracts so we
define a tract as all the axons that

0:11:53.810,0:11:58.130
share a common origin and destination
and that's what a tract is and you'll

0:11:58.130,0:12:02.030
notice that the tracks that we're
talking about exist in the white matter

0:12:02.030,0:12:06.920
of the spinal cord here we have the
posterior column lateral white column

0:12:06.920,0:12:11.570
and the anterior white column as we just
said and so these neurons the axons of

0:12:11.570,0:12:15.440
these neurons are grouped into these
areas in the spinal white matter now

0:12:15.440,0:12:19.610
importantly a sending tracts conduct
sensory impulses to the brain in other

0:12:19.610,0:12:23.390
words these are going up the spinal cord
descending tracts on the other hand

0:12:23.390,0:12:28.310
conduct motor impulses down the spinal
cord so as an example we have this tract

0:12:28.310,0:12:32.120
here and this would be sending impulses
down so how do I know that how do I know

0:12:32.120,0:12:36.620
that the corticospinal tract is a
descending tract well take a look at the

0:12:36.620,0:12:41.150
way these are named the tracts are
typically named for their place of

0:12:41.150,0:12:44.690
origin which comes first and the
termination which comes second

0:12:44.690,0:12:47.800
so on the one that I just pointed out
which is the cortical spinal tract

0:12:47.800,0:12:53.210
notice cortical is the first portion of
this this is where this tract begins and

0:12:53.210,0:12:58.070
cortical refers to the cortex spinal is
the second portion of this and tells you

0:12:58.070,0:13:01.850
where this tract terminates this would
be in the spinal cord so because this is

0:13:01.850,0:13:07.220
going from the cortex to the spinal cord
we know it's a descending tract and from

0:13:07.220,0:13:12.140
what we've already talked about
we know that descending means motor so

0:13:12.140,0:13:16.160
we know that the corticospinal tract is
a motor tract another example here we

0:13:16.160,0:13:20.870
have a spinal cerebellar tract
what kind of tract is that? well it

0:13:20.870,0:13:25.040
starts here in this

spinal cord and cerebellar as you might

0:13:25.040,0:13:29.570
guess refers to the cerebellum so in
fact these impulses are coming from the

0:13:29.570,0:13:34.010
spinal cord and going to the cerebellum
so with this being a sending or

0:13:34.010,0:13:38.090
descending tract right it will be an a
sending tract conducting sensory

0:13:38.090,0:13:42.290
impulses up to the cerebellum and this
is the naming convention of all of these

0:13:42.290,0:13:46.340
basically you can guess what kind of
information these tracts are carrying

0:13:46.340,0:13:49.880
and this is really what I want you to
know for the exam you should be able to

0:13:49.880,0:13:54.350
tell me whether or not the tract is
ascending or descending and what kind of

0:13:54.350,0:13:59.660
information in terms of sensory or motor
that particular tract is carrying we

0:13:59.660,0:14:03.080
have a couple of exceptions to this
general rule there always all right so

0:14:03.080,0:14:08.060
we have these back wedge-shaped portions
here one called the fasciculus gracilis

0:14:08.060,0:14:13.430
one called a fasciculus cuneatus both
of these are sensory and these are not

0:14:13.430,0:14:17.060
named according to the same scheme that
we talked about a second ago so these

0:14:17.060,0:14:20.390
are not named for the place of origin
and termination instead you just have to

0:14:20.390,0:14:24.020
remember that these two tracts carry
sensory information which we're going to

0:14:24.020,0:14:27.230
look at in a second and then the other
thing we talked about if you remember is

0:14:27.230,0:14:31.550
that impulses that originate on the
right side of the brain for example in

0:14:31.550,0:14:35.660
the precentral gyrus they'll cross over
and eventually control things on the

0:14:35.660,0:14:38.750
left side of the body and where this
usually happens is right around the

0:14:38.750,0:14:43.160
medulla and so clinically what I have
here clinically what this will mean as

0:14:43.160,0:14:47.030
we talked about when we talked about for
example stroke victims it means that

0:14:47.030,0:14:51.530
something that affects the right side of
the upper nervous system might manifest

0:14:51.530,0:14:55.160
on the left side of the lower nervous
system okay so let's take a closer look

0:14:55.160,0:15:00.020
at the tracts of the white matter first
we're going to look at ascending tracts

0:15:00.020,0:15:05.930
right so the ascending tracts we know a
sending corresponds to sensory so we're

0:15:05.930,0:15:09.800
going to be looking at sensory tracts
here and the three different sensory

0:15:09.800,0:15:13.850
tracts that we have are what I mentioned
a second ago fasiculus cuneatus and

0:15:13.850,0:15:18.650
fasciculus gracilis these control fine

touch pressure body movement and they

0:15:18.650,0:15:23.330
also cross or decussate in the
medulla we just mentioned that here for

0:15:23.330,0:15:27.470
example we can see the medulla and you
can get a view of how these actually

0:15:27.470,0:15:32.510
cross over you can see that the sensory
tracts come in on the left side will

0:15:32.510,0:15:35.840
cross over to the right side and they'll
wind up at the right post

0:15:35.840,0:15:39.080
central gyrus of the cerebrum so
remember that's the primary

0:15:39.080,0:15:42.820
somatosensory cortex that we talked
about before and so you can see this

0:15:42.820,0:15:47.570
crossing over and crossing over in fact
is called as you see on the bottom of

0:15:47.570,0:15:52.490
the slide decussation so we say that
they decussate or cross over in the

0:15:52.490,0:15:56.150
medulla some things actually cross over
in the spinal cord and you can see that

0:15:56.150,0:15:59.480
on the bottom of the slide here now a
second track that we have that the

0:15:59.480,0:16:03.230
sensory tract is called the spinal
column a how would we know just from the

0:16:03.230,0:16:06.800
name that it's an a sending or sensory
tract spinal comes first

0:16:06.800,0:16:10.430
therefore this information is
originating in the spinal cord and it's

0:16:10.430,0:16:15.050
going to the thalamus
so spinal column thalamic once again ascending

0:16:15.050,0:16:19.430
or sensory information and then we also
have spinal cerebellar we mentioned this

0:16:19.430,0:16:23.390
tract on the previous slide this is also
sensory and you'll see that this carries

0:16:23.390,0:16:27.890
subconscious movements from muscles one
of the things I do want to mention here

0:16:27.890,0:16:32.990
is that you'll notice also that we have
different orders of neurons I'm going to

0:16:32.990,0:16:35.930
talk about this in the next slide but
notice that we have these three

0:16:35.930,0:16:40.430
different orders or three different
levels of neurons as I've indicated with

0:16:40.430,0:16:44.000
these arrows on the right side of the
figure so we basically have neurons that

0:16:44.000,0:16:48.530
come from the organ into the spinal cord
and then we have neurons that synapse

0:16:48.530,0:16:52.400
with that and go up usually to the
thalamus because if you remember the

0:16:52.400,0:16:56.300
thalamus is the gateway for sensory
information that's coming to the cortex

0:16:56.300,0:17:01.280
and then finally from the thalamus up to
the cortex we have these last group of

0:17:01.280,0:17:05.300
neurons I'm going to reiterate this in a
second but remember that we're not aware

0:17:05.300,0:17:09.830
or conscious of anything until it either

comes to or goes from the cerebral

0:17:09.830,0:17:15.410
cortex so anything down here anything
from here all the way down we're not

0:17:15.410,0:17:19.880
aware of this we're not aware of any of
the impulses or sensations that are

0:17:19.880,0:17:25.400
traveling around this area not until
they get here in the cerebral cortex so

0:17:25.400,0:17:28.040
something to be aware of this is one of
the reasons why it says here

0:17:28.040,0:17:32.540
spinocerebellar is a subconscious
coordination of muscle movements

0:17:32.540,0:17:36.410
bringing sensory information and telling
us where muscles are going spinal

0:17:36.410,0:17:40.970
thalamic it will also be subconscious so
we won't be aware of the impulses that

0:17:40.970,0:17:44.900
are coming from the spinal cord and
going up to the thalamus not until those

0:17:44.900,0:17:48.870
additional neurons bring those signals
up to the cerebral cortex

0:17:48.870,0:17:52.710
so let's talk a little bit about these
numbers that I have on the neurons here

0:17:52.710,0:17:57.600
we have what we call orders of sensory
neurons notice that we have a first

0:17:57.600,0:18:01.980
order a second order and a third order
and as I mentioned a second ago the

0:18:01.980,0:18:06.059
first order neurons come from the organ
into the spinal cord and you see that

0:18:06.059,0:18:10.440
here the second order neuron synapse
with the first order of course and they

0:18:10.440,0:18:15.000
bring information up to the thalamus and
in this case you can see that the neuron

0:18:15.000,0:18:17.040
that we're looking at here is crossing
over

0:18:17.040,0:18:20.520
so the axon is crossing over to the
other side and then from the thalamus up

0:18:20.520,0:18:24.990
to the cerebral cortex we have the third
order neurons so it's actually not until

0:18:24.990,0:18:29.040
signals go from the thalamus or wherever
they're going below the cerebral cortex

0:18:29.040,0:18:33.540
up to the cerebral cortex that were
aware of them so once again everything

0:18:33.540,0:18:38.790
that's down here is all subconscious
information we're not aware of it until

0:18:38.790,0:18:43.830
it gets up here to the cerebral cortex
and these are called first second and

0:18:43.830,0:18:47.610
third order sensory neurons
here's that term decussation again

0:18:47.610,0:18:51.330
once again this means crossing over now
what about the descending tracts well

0:18:51.330,0:18:56.160
descending if you remember here we're
talking about motor impulses so these

0:18:56.160,0:19:01.350
are carrying signals down from the brain
the cerebrum basically two motor

0:19:01.350,0:19:05.490
structures in the body we have several

of these we have a corticospinal which I

0:19:05.490,0:19:08.850
mentioned when we were talking about the
organization of the gray matter this is

0:19:08.850,0:19:13.890
for voluntary movement of skeletal
muscles so cortical spinal begins in the

0:19:13.890,0:19:18.750
cortex goes down the spinal cord
reticulospinal this originates from the

0:19:18.750,0:19:22.410
reticular system that we talked about a
while ago remember this is all

0:19:22.410,0:19:26.520
throughout the brainstem this comes from
the reticular system down the spinal

0:19:26.520,0:19:30.480
cord so once again this is descending
information and finally we have

0:19:30.480,0:19:35.910
information coming from a red nucleus in
the brain which is rubro is the Latin

0:19:35.910,0:19:39.630
word for red so this comes from a red
nucleus in the brain down the spinal

0:19:39.630,0:19:43.860
cord and this is also carrying motor
information as well now one of the

0:19:43.860,0:19:47.940
differences you'll see here is that the
motor neurons in the descending tracts

0:19:47.940,0:19:52.440
are set up a bit differently instead of
having orders of neurons as we saw

0:19:52.440,0:19:57.179
before with the sensory we have upper
and lower when you talk about upper

0:19:57.179,0:20:01.590
motor neurons these begin in the
precentral gyrus of the cortex so

0:20:01.590,0:20:04.020
remember
this is the one that's motor associated

0:20:04.020,0:20:07.200
so this would come down from the
cerebral cortex come all the way down

0:20:07.200,0:20:11.520
cross over maybe in the medulla and go
to the opposite side of the spinal cord

0:20:11.520,0:20:16.770
at the level where that neuron is going
to innervate muscle for example and it's

0:20:16.770,0:20:21.210
here then this neuron that comes from
the spinal cord and goes to the organ we

0:20:21.210,0:20:25.860
refer to these as lower motor neurons
this is of course important because we

0:20:25.860,0:20:30.059
have some diseases that affect upper
motor neurons some diseases that affect

0:20:30.059,0:20:34.950
lower motor neurons so when we talk
about motor tracts the descending tracts

0:20:34.950,0:20:39.630
we define these as being either upper or
lower when we talk about the sensory

0:20:39.630,0:20:45.450
tracts we talk about them being either
first second or third order of neurons

0:20:45.450,0:20:52.320
okay so that will do it for the fifth
part of lecture 19 on spinal cord

0:20:52.320,0:20:55.520
I'll talk to you soon