Acland's DVD Atlas of Human Anatomy

Transcript for Volume 5

PART 1

THE FACIAL MUSCLES AND THE SCALP

00.00

This tape is the second of two that describe the head and neck. In it, we'll look first at the facial muscles and the scalp, then at the brain and its surroundings, then at the nerves and blood vessels of the head and neck, then at the eye, and the ear.

00.18

FACIAL MUSCLES

We'll start by looking at the face. Some important parts of the face, the nose and the orbit, are covered separately in these two tapes. In this section we'll focus on the facial muscles, which produce the movements of facial expression. We'll go from above down, starting with the muscle that closes the eye, the orbicularis oculi.

00.39

All this is the orbicularis oculi. It surrounds the opening between the upper and lower lids, the palpebral aperture. Orbicularis oculi has an inner or palpebral part, and an outer or orbital part. The palpebral part is extremely thin, the orbital part is more substantial

01.03

Orbicularis oculi arises medially from this underlying structure, the medial palpebral ligament, and from the bone above and below it. Its fibers pass above and below the palpebral aperture, joining with each other here.

01.19

When the palpebral part of the muscle contracts, the eyelids close gently. When the whole muscle contracts, they close tightly. Opening the eye is caused by elastic forces acting on the lower lid, and by a more deeply placed levator muscle acting on the upper lid, that we'll see later in this tape.

01.39

Now we'll move down to look at the muscles around the mouth and the nose. The opening between the lips, the oral commisure, is surrounded by the orbiculartis oris muscle. Here's part of it. The orbicularis is joined and overlaid by several other facial muscles which we'll remove from the picture for a moment.

02.01

Here's the orbicularis oris by itself. Its more superficial fibers encircle the oral commisure, some of them arising from bone here. Its deeper fibers are continuous with those of the buccinator muscle, as we saw in the previous tape. The action of orbicularis oris is to close the oral commisure, and press the lips together.

02.25

The deep hollow here between the buccinator and masseter muscles is filled with this buccal fat pad, which is continuous with the fat that covers the front of the cheek.

02.39

Now we'll return to the picture all except one of the muscles that pull on the orbicularis oris. Pulling on it from above and behind is the zygomaticus major, which arises from here on the zygomatic bone. Pulling on it from behind is the risorius muscle. We use both these muscles when we smile.

03.00

Pulling on the orbicularis from above are zygomaticus minor, absent in this instance, levator anguli oris, and levator labii superioris. These arise from here on the maxilla. Together they raise the upper lip.

03.18

The most medial corner of levator labii superioris, which goes by this very impressive name, [levator labii superioris alaequae nasi] attaches to the alar cartilage of the nose. It does this. Here on the side of the external nose is the nasalis muscle. It helps to wrinkle the nose.

03.35

The three muscles that join the orbicularis from below are quite hard to tell apart. They're depressor anguli oris, depressor labii inferioris, and mentalis.

03.37

The last two run into one another, and are embedded in this mass of fat and fibrous tissue which forms the prominence of the chin. These three muscles arise from here on the mandible. Between them they pull the lower lip downward, and pucker the chin.

04.03

The last muscle we'll add to the picture, the platysma, lies partly in the face but mainly in the neck. Here's the neck as we saw it in the last tape, without the platysma. Here are the sternocleidomastoid muscle, the infrahyoid muscles, and the digastric muscle.

04.23

Now we'll add the platysma to the picture. All this is platysma. It lies within the subcutaneous fascia of the neck. Its lowest fibers extend below the clavicle, onto the chest. Platysma has a free posterior border here, and a free anterior border here near the midline.

04.48

Most of the fibers of platysma insert here along the border of the mandible, but its more posterior fibers cross the mandible, and insert into the orbicularis oris muscle complex. The platysma muscle pulls the corner of the mouth downwards and backwards, producing these ridges to appear beneath the skin.

05.07

SCALP

Now we'll move on to look at the scalp. To understand the scalp we'll start with a dissection in which all its layers have been removed, exposing the skull.

05.16

The dome of the skull, known as the calvaria, is formed by bones that we've seen in the previous tape, the frontal, parietal, and occipital, bones, and on the side by the squamous part of the temporal bone. The temporal bone is covered by the investing deep fascia of the temporalis muscle.

05.39

Overlying the calvarium is a layer of loose connective tissue, the areolar layer. It overlies the deep temporal fascia, too. The areolar layer separates the bone from the next layer that we'll add, the assembly of structures known collectively as the epicranium. The epicranium is formed partly by tendon, partly by muscle. To see it better, we'll add all of it to the picture.

06.12

Over the dome of the skull the epicranium is formed by a sheet of tendon that's known as the galea, or galea aponeurotica. Two muscles are attached to the galea, in front, the frontalis, and behind, the occipitalis.

06.32

The occipitalis muscle arises from here on the occipital bone, above the superior nuchal line. It inserts into the galea. The frontalis muscle arises from the galea, and inserts into the skin of the lower part of the forehead, close to the eyebrow.

06.54

These two muscles produce important movements of facial expression. When occipitalis and frontalis act together, the eyebrows rise. When frontalis acts by itself, the forehead is pulled downward in a frown.

07.11

The full effect of a frown comes from the added effect of these not very separate muscles, depressor supercilii and procerus, and by the more deeply placed corrugator supercilii, which pulls the eyebrow medially causing these vertical wrinkles.

07.32

On the side of the head, the epicranium is formed by this area of dense connective tissue, the superficial temporal fascia. In some individuals, as in this this different specimen, the epicranium includes the vestigial auricularis muscles, which can move the external ear.

07.57

Now we'll add the more superficial part of the scalp to the picture. Firmly attached to the epicranium is a layer of fibrous tissue interlaced with fat. Above this is the hair bearing skin of the scalp. These are the hair follicles, which extend through the thickness of the skin.

08.22

That brings us to the end of this brief section. Now, let's review what we've seen of the facial muscles and the scalp.

08.30

REVIEW

Heres the orbicularis oculi: its palbebral part, and its orbital part. Here's orbicularis oris. Here are the risorius, zygomaticus major, levator anguli oris, levator labii superioris and nasalis muscles. Here are depressor anguli oris, depressor labii inferioris, and mentalis, and here's platysma.

09.06

Here's the areolar layer of the scalp, here's the epicranium, consisting of the galea, the frontalis, and occipitalis muscles, and the superficial temporal fascia. Here are the procerus, the depressor, and the corrugator supercilii.

09.29

That brings us to the end of this section on the facial muscles and the scalp. In the next section we'll move on to look at the brain.

09.42

END OF PART 1

PART 2

THE BRAIN AND ITS SURROUNDINGS

00.00

In this section we'll first take a brief look at the shape of the brain and its main parts, then we'll look at the cavity that contains it and the layers of tissue that surround it, then we'll return to the brain itself and look at it in more detail.

0020

BRAIN: INITIAL OVERVIEW

Here's the brain. Much the largest part of the brain is the cerebrum. The cerebrum is partly divided in the mid-line into two cerebral hemispheres. Below the cerebrum and separate from it is the smaller cerebellum. The cerebrum and the cerebellum both grow out of the brainstem. The brainstem becomes continuous below with the spinal cord. The brain is contained within the cranial cavity.

00.56

CRANIAL CAVITY AND MENINGES

Here's the cranial cavity in a dry skull. It's almost the same shape as the brain. As we saw in the last tape, two big steps divide the floor of the cavity into three parts.

01.10

The sphenoid ridges separate the anterior cranial fossa from the middle cranial fossa. This part of the cerebrum, the frontal lobe, occupies the anterior cranial fossa, this part, the temporal lobe occupies the middle cranial fossa.

01.27

The petrous temporal bones separate the middle cranial fossa from the posterior cranial fossa. The posterior cranial fossa contains the cerebellum and the brainstem. Here's the foramen magnum.

01.41

Now let's see how the cranial cavity looks in the living body. The cranial cavity is lined throughout by this layer of tough, shiny fibrous tissue, the dura.

01.53

Below, the layer of dura passes through the foramen magnum, becoming continuous with the dura that lines the vertebral canal. Two important extensions of the dura create partitions within the cranial cavity. They're the falx and the tentorium.

02.11

Here's the tentorium. Its full name is tentorium cerebelli. It separates the posterior cranial fossa from the rest of the cranial cavity, and separates two major parts of the brain, the cerebrum above from the cerebellum below.

02.31

This opening in the tentorium is called the tentorial incisure. The brain stem passes through it. The tentorium is attached along this lie on the occipital bone, and along the edge of the petrous temporal bone. Its attachment ends at the posterior clinoid process.

02.53

The upper surface of the tentorium is continuous with the dura of the floor of the middle cranial fossa. In the midline, the tentorium is attached to the other major partition, the falx, which we'll add to the picture.

03.07

This is the falx. Its full name is falx cerebri. The falx forms a mid-line partition between the two cerebral hemispheres. Here's its attachment to the tentorium.

03.23

Along its length it's attached to the occipital, parietal and frontal bones. Here in front the falx is attached to the crista galli. To see the falx in cross section we'll divide it along this line.

03.39

Near its attachment the falx splits into two layers, leaving a triangular space for the superior sagittal sinus, an important part of the brain's venous drainage system, as we'll see later in this tape.

03.53

Now we'll move on to look at the layers of tissue that give the brain a protective covering, and maintain its special fluid environment. These three layers, the dura, the arachnoid and the pia, are collectively called the meninges. We've already taken an inside look at the outer layer, the dura.

04.11

To see the two inner layers, the pia and the arachnoid, we need to add the brain itself to the picture. We're looking at the right cerebral hemisphere. The blood vessels on its surface have been filled with red latex. The surface of the brain is richly folded. An outward fold is called a gyrus, an inward fold is a sulcus.

04.36

The pia is almost invisibly thin. It's just the glossy surface that we see here. To see the extent of the pia we'll look at a frontal section. Here's a typical sulcus. The pia extends down into each sulcus, and back up onto the next gyrus. Each sulcus contains blood vessels which lie just outside the pia. Each vessel that enters the brain carries a sleeve of pia with it.

05.08

Now we'll add the arachnoid to the picture. This is the arachnoid. It's a delicate transparent membrane. Here's the arachnoid again. Unlike the pia, the arachnoid doesn't extend into the sulci. It bridges over, from one gyrus to the next. In this specimen the subarachnoid space is empty. Here we're injecting water to fill it.

05.45

Over most of the brain the subarachnoid space is narrow, but in a few places it's quite wide, notably here below the cerebellum, here above the cerebellum, and here in front of the top of the brainstem. These spaces are called cisterns.

06.02

Outside the arachnoid is the dura. We'll add it to the picture. The dura is a much tougher layer of tissue than either the pia or the arachnoid. The dura has almost no attachment to the arachnoid. The dura can be separated from the overlying bone, but is normally quite closely attached to it.

06.28

Now we'll add the rest of the dura to the picture. Here's the intact dura. These branches of the middle meningeal artery, which runs in the thickness of the dura.

06.42

To look at the openings in the dura, we'll again look at it from the inside in an empty skull. The vessels and nerves that enter and leave the cranial cavity pass though openings in the dura. At each opening the dura forms a tunnel around the nerve or vessel for a short distance.

07.02

Typically a nerve or a blood vessel runs beneath the dura for a distance between its opening in the dura and its opening in the bone, so the openings in the dura often don't match the openings in the bone. The difference between dural and bony openings is specially marked here in the middle cranial fossa.

07.22

As we saw in the previous tape, the bone here has many openings. By contrast the dura here has no openings. The corresponding openings in the dura are either up here, or back here.

07.37

As we'll see in later sections the central part of the middle cranial fossa is a specially busy area. Let's take a further look at it.

07.48

In the dry skull this hollow, the pituitary fossa, is partly enclosed by these four bony projections, the clinoid processes. In the living body the dura bridges over the roof of the pituitary fossa, leaving this round opening. The clinoid processes are here.

08.09

The pituitary fossa, which contains the pituitary gland, is lined with dura. Just lateral to the pituitary fossa is the cavernous sinus, which is hidden beneath the dura here.

08.22

This opening in the dura, which is for the trigeminal nerve, leads into a side cavity under here, the trigeminal cave, which is occupied by the trigeminal ganglion.

08.33

We'll see more of this busy area later in this tape, when we look at the vessels and nerves. Now we're almost ready to move on to look at the brain. Before we do that, let's review what we've seen of the cranial cavity and the meninges.

08.49

REVIEW

Here are the sphenoid ridges, and the petrous temporal bones, the anterior cranial fossa, middle cranial fossa, and posterior cranial fossa. Here's the dura on the outside, and on the inside.

09.17

Here are the falx, the tentorium, and the tentorial incisure. Here's the arachnoid, here's the pia. Here are the cisterns.

09.35

Here are the clinoid processes, and the pituitary fossa in the dry skull. Here are the same structures in a dissected specimen. Here's the site of the cavernous sinus, and of the trigeminal cave.

09.58

BRAIN

Now we'll move on to look at the brain. The internal structure of the brain, which is extremely complex, lies outside the scope of this atlas. In this section we'll look at the main external features of the brain, and also at the cavities within it, the ventricles.

10.22

This model shows the shape of the ventricular system. It's formed by two small cavities in the mid-line, the third ventricle, and fourth ventricle, and two much larger cavities, the lateral ventricles, which connect to the third ventricle here. It's the third ventricle, because the lateral ventricles are counted as the first two.

10.46

The ventricles are filled with cerebrospinal fluid. We'll see more of them as we go along. To understand the external features of the brain we'll start with the central stalk, which is known as the brainstem. To look at it, we'll take the rest of the brain out of the picture.

11.07

Here's the brainstem. It consists of the medulla, the pons, and the midbrain. The brainstem contains tracts that connect the cerebrum, the cerebellum and the spinal cord; and it contains nuclei that serve basic autonomic functions. It's also the origin of nearly all the cranial nerves.

11.29

The medulla is cone shaped. It tapers down to become continuous with the spinal cord. The medulla becomes continuous with the spinal cord here at the foramen magnum.

11.42

The medulla, the pons and the midbrain are located just behind the basilar part of the occipital bone, and the dorsum sellae. The dorsal aspect of the medulla faces almost directly backwards. The back of the upper part of the medulla forms the floor of the fourth ventricle. On the model, this is the fourth ventricle, this is the floor.

12.11

This arch of tissue is the superior medullary velum, which forms the roof of this part of the ventricle. This delicate tissue, the inferior medullary velum, forms this part of the roof.

12.32

This cut surface is the attachment of the cerebellum. It's described as consisting of the superior, middle, and inferior cerebellar peduncles, which are somewhat fused together. The ventral aspect of the medulla is marked on each side by these bulges, the pyramid, and the olive.

13.00

Emerging from the ventral and lateral surfaces of the medulla are the filaments of the four lowest cranial nerves, the twelfth, the hypoglossal; the eleventh, the accessory; the tenth, the vagus; and the ninth, the glossopharyngeal.

13.19

Here's the brain stem in situ, seen from behind,. The tentorium has been removed to give us this view. Here's the cerebellum, divided in the midline. Here's the divided cerebellar peduncle. Here are the filaments of the hypoglossal nerve making their exit from the cranium.

13.44

Here are the accessory, vagus, and glossopharyngeal nerves making their exit together through one opening. Above the medulla is the pons. On each side the pons becomes continuous with the middle cerebellar peduncle.

14.02

Arising from the groove between the pons and the medulla are the next three cranial nerves. They're the eighth, the vestibulo-cochlear; the seventh, the facial; and the sixth, just visible, the abducent. The fifth cranial nerve, the trigeminal emerges from the upper part of the pons.

14.26

Here's the middle cranial fossa, here's the petrous temporal bone, here's the pons. Here are the facial and vestibulo-cochlear nerves together, here's the trigeminal nerve, here's the abducent nerve.

14.48

The part of the brainstem above the pons is the mid-brain. Features of its dorsal surface are the upper part of the roof of the fourth ventricle, the superior cerebellar peduncles, these bulges, the inferior and superior colliculi, and in the mid-line the pineal body. The fourth cranial nerve, the trochlear, emerges from the dorsum of the midbrain.

15.18

The mid-brain spreads out into these two massive columns, the cerebral peduncles, which connect the brainstem to the cerebrum.

15.30

Here are the cerebral peduncles in the intact brain. They're largely hidden by the lower parts of the cerebral hemispheres, the temporal lobes. To see the cerebral peduncles better, we'll look at a brain in which the temporal lobe, and the cerebellum have been removed.

15.56

Here are the cerebral peduncles again. Here on the outside of the cerebral peduncle are the medial geniculate body, and the lateral geniculate body, which gives rise to the optic tract. Between the cerebral peduncles the third cranial nerve, the oculomotor, emerges.

16.16

We'll return to the intact brain. Here are the two oculomotor nerves. Here are the two optic tracts. They meet at the optic chiasm. From the optic chiasm the two optic nerves emerge. They're the second cranial nerves.

16.37

Here's the brain in situ with the right cerebral hemisphere removed. Here's the corpus callosum, which joins the two cerebral hemispheres, here's the divided cerebral peduncle, here's the midbrain. Here's the floor of the middle cranial fossa. Here's the optic nerve, running forwards beneath the dura toward the optic canal. Here's the oculomotor nerve, here's the trochlear nerve.

17.11

The ventral aspect of the brain passes upwards to here, then turns a corner and continues forwards into a complicated area that we'll look at later in this section.

17.23

Now that we've looked at the brainstem, we'll move on to look at the cerebellum.

17.30

Here are the brainstem and the cerebellum together. The main functions of the cerebellum have to do with balance, motor co-ordination, and the control and monitoring of intentional movements. The cerebellum occupies most of the posterior cranial fossa. The tentorium is just above it.

17.51

To see the cerebellum better, we'll look at it by itself. The surface of the cerebellum is marked by many parallel fissures, some deeper than others. This deep primary fissure divides the cerebellum into a small anterior lobe and a large posterior lobe.

18.16

A deep groove on the underside partially divides the cerebellum into two hemispheres. These are joined by this midline mass, the vermis, which extends all the way round from the top, to the underside.

18.35

Here are the divided cerebellar peduncles, the superior one from the midbrain, the inferior one from the medulla, and the middle one As we've seen, the middle cerebellar peduncle becomes, continuous with the pons.

18.52

This cavity in the anterior aspect of the cerebellum is the most posterior part of the roof of the fourth ventricle, that's this part on the model.

19.05

Now we'll move on to look at the cerebrum. Here's the cerebrum with the brainstem attached and the cerebellum removed.

19.15

The functions of the cerebrum include the senses of, vision, hearing, smell, touch and spatial perception, and also speech and language, memory, thought and voluntary action. The cerebrum is formed mainly by the two cerebral hemispheres. These are separated in the midline by the falx, which occupies this longitudinal cerebral fissure.

19.40

Though they look hemispherical from in front, the shape of each cerebral hemisphere is more complex when seen from the side. In front this part, the frontal lobe, occupies the anterior cranial fossa. This part below, the temporal lobe, occupies the middle cranial fossa. This part behind, the occipital lobe, lies above the tentorium.

20.07

The two cerebral hemispheres are connected across the midline by the corpus callosum, which runs all the way from here in front, to here behind. The two cerebral hemispheres are connected below by the two cerebral peduncles converging on the brainstem. They're also connected by the structures of this area, the floor of the third ventricle.

20.34

To see these connecting structures better we'll look at a brain that's been divided in the mid-line. Here's the corpus callosum. This is the cerebral peduncle.

20.51

The third ventricle is here. Here's the third ventricle on the model: it's quite narrow from side to side. This is the floor of the third ventricle.

21.04

The surface of each cerebral hemisphere is richly folded. Each inward fold, or sulcus, and each outward fold, or gyrus, has a name, but here we'll name only two, the central and the lateral sulci.

21.24

This is the lateral sulcus. It's very deep. It extends all the way round to here on the underside. Here's the medial end of the lateral sulcus in the intact brain. The lateral sulcus separates the frontal lobe above from the temporal lobe below.

21.46

This long sulcus running upwards and backwards is the central sulcus. It's the only one that runs all the way to the medial surface of the hemisphere.

21.56

The cerebral hemisphere is described as consisting of four lobes, the frontal, temporal, and occipital lobes that we've mentioned already, and the parietal lobe. Between the frontal lobe and its neighbors the central and lateral sulci form natural boundaries. The other boundaries are somewhat arbitrary.

22.20

Here are the four lobes on the medial surface: frontal, parietal, occipital, and temporal. The sloping underside of the occipital lobe conforms to the upward slope of the tentorium.

22.36

Here are the two temporal lobes seen from below. This part of the tip of the temporal lobe is the uncus. The uncus lies just above the tentorial incisure, which is here.

22.54

Here on the underside of the frontal lobe is the olfactory tract. It ends in the olfactory bulb, from which the fibers of the first cranial nerve, the olfactory nerve, emerge.

23.05

Each cerebral hemisphere contains a cavity, the lateral ventricle, that's filled with cerebrospinal fluid. The lateral ventricle has an anterior horn, a body, a posterior horn, and an inferior horn. The anterior horn is in the frontal lobe, the body is in the parietal lobe, the posterior horn is in the occipital lobe, and the inferior horn curls downward and forward into the temporal lobe.

23.42

To see where the lateral ventricle communicates with the third ventricle we'll go round to a medial view. The communication is here, at the interventricular foramen.

23.55

To see how the lateral ventricle, the third ventricle, and the fourth ventricle are connected, we'll look at a brain that's been divided in the midline.

24.07

Here's a midline section through the third ventricle. Here's the third ventricle. This strand of vascular tissue in the roof of the ventricle is the choroid plexus, which produces cerebrospinal fluid. Here's the interventricular foramen, opening into the lateral ventricle.

24.27

The choroid plexus passes through the foramen, and continues into the lateral ventricle. The cerebrospinal fluid that's formed in the lateral and third ventricles passes through this narrow passage, the cerebral aqueduct, and into the fourth ventricle.

24.44

Fluid leaves the fourth ventricle through three openings, the lateral apertures (the right one is in the depths of this recess) and the medial aperture, which is in the mid-line here. It's easier to visualize the medial opening in this dissection. Here it is, in the inferior medullary velum. The lateral openings are here.

25.09

The medial opening comes out here between the cerebellum and the medulla. The lateral opening on each side comes out just below the cerebellar peduncles.

25.22

These openings lead to the subarachnoid space surrounding the brain and spinal cord. We'll see where the cerebrospinal fluid is absorbed later in this tape, when we look at the blood vessels.

25.35

We'll return now to the underside of the cerebrum, to look at the structures that form the floor of the third ventricle, which is here. Here's the optic chiasm. Behind it this tubular structure that's been divided, is the infundibulum, the stalk of the pituitary gland. These two projections are the mamillary bodies.

26.00

To see how the pituitary gland is attached to the brain we'll look at an intact specimen divided in the midline. Here's the floor of the third ventricle, here's the optic chiasm, here's the infundibulum, leading down to the pituitary gland or hypophysis. The anterior and posterior parts of the pituitary gland are quite distinct.

26.29

The pituitary gland sits in the pituitary fossa. The pituitary fossa bulges downwards into the roof of the sphenoid sinus. This area just above the pituitary stalk is the hypothalamus.

26.44

In the dissections we've seen so far, including this one, the picture has been simplified by removing the important arteries that surround the base of the brain and run in the major sulci. We'll see these later in this tape. Now let's review what we've seen of the brain.

27.07

REVIEW

Here's the cerebrum, the cerebellum, and the brainstem. Here are the medulla, the pons, and the midbrain

27.25

Here's the superior medullary velum, the floor of the fourth ventricle, and the inferior medullary velum. Here are the cerebellar peduncles, superior, middle, and inferior. Here are the pyramid, and the olive

27.47

Here are the filaments of the hypoglossal, accessory, vagus, and glossopharyngeal nerves, the vestibulo-cochlear, and facial nerves, the abducent nerve, and the trochlear nerve.

28.06

Here are the colliculi, inferior and superior and the pineal body. Here's the medial geniculate body, the lateral geniculate body, and the optic tract.

28.21

On the cerebellum, here's the primary fissure, the anterior, and posterior lobes, the vermis, and the roof of the fourth ventricle.

28.34

Here are the cerebral hemispheres, here's the corpus callosum. Here are the frontal, parietal, occipital, and temporal lobes.

28.46

Here are the oculomotor nerve, the optic chiasm, the optic nerves, the infundibulum, and the mammillary bodies.

28.59

In the model here are the lateral ventricles, the third ventricle, and the fourth ventricle. Here's the third ventricle, the interventricular foramen, the choroid plexus, the cerebral aqueduct, and the fourth ventricle. Here's the hypothalamus. Here's the infundibulum, and the pituitary gland.

29.29

That brings us to the end of this section on the brain. In the next section we'll look at the cranial nerves.

29.41

END OF PART 2

PART 3

THE NERVES OF THE HEAD AND NECK

00.00

In this section we'll look at the twelve cranial nerves, the sympathetic trunk, and the cervical nerves.

00.16

The cranial nerves are numbered by the order in which they leave the cranial cavity. Earlier in this tape we saw them emerging from the brain. In this section we'll follow the course of each nerve, look at its principal branches, and summarize its functions.

00.30

CRANIAL NERVES I - VI

We'll begin with the first six cranial nerves. The first, the olfactory, and the second, the optic transmit our senses of smell and of eyesight. The third, the oculomotor, the fourth, the trochlear, and the sixth, the abducent, are motor nerves to the eye muscles; and the fifth, the trigeminal is a large motor and sensory nerve to the face and jaws.

00.56

The first cranial nerve, the olfactory nerve is extremely short. It consists of a series of fine filaments which arise from the olfactory bulb on the underside of the frontal lobe. On each side the olfactory bulb lies here, just above the cribriform plate.

01.17

Here's a frontal section in the dry skull that goes through the cribriform plates: they're here. On each side the cribriform plate forms the narrow roof of the nasal cavity. Here's a medial view of the nasal cavity. The cribriform plate is here.

01.35

The filaments of the olfactory nerve, here they are in close-up, pass through the cribriform plate and run just beneath the mucous membrane to reach nerve endings in this olfactory area on the lateral and medial surfaces of the nasal cavity.

01.50

The next nerve we'll look at is the second cranial nerve, the optic nerve. We've seen the proximal ends of the optic nerves, emerging from the optic chiasm.

02.02

Here's the optic nerve, passing forward beneath the dura to enter the optic canal, which starts here. Here's the optic canal in the dry skull. Here on each side of the optic chiasm are the divided internal carotid arteries.

02.28

Just beneath the chiasm is the roof of the pituitary fossa: here's the divided stalk of the pituitary gland. To follow the optic nerve, we'll remove the roof of the orbit, leaving the optic canal intact. We'll remove this nerve, and the orbital fat, and these two muscles, which we'll see later.

02.58

Here's the optic nerve. It enters the orbit between the tendons of origin of the rectus muscles. It passes forwards and laterally, to enter the back of the eyeball.

03.11

Strictly speaking the optic nerve isn't a nerve, it's an extension of the brain. It's covered throughout its course by extensions of all three meningeal layers, dura, arachnoid and pia.

03.23

Here we've made a window in the dura surrounding the optic nerve. Here's the edge of the dura, here's the nerve itself, here's the arachnoid. The dura is continuous with the outer layer of the eyeball, the sclera. We'll be returning here shortly. For now we'll put the contents of the orbit back in place.

03.50

The optic chiasm is a cross-over point for optic nerve fibers. The fibers of each nerve that connect to the medial half of the retina cross over into the opposite optic tract. The fibers that connect to the lateral halves of the retinae stay on the same side.

04.08

Now we'll move on to look at the third, fourth and sixth cranial nerves: the oculomotor, trochlear, and abducent. They're motor nerves. Between them they supply the six muscles that move the eye, and also the levator of the upper lid. As we've seen, the oculomotor nerve arises between the cerebral peduncles, the trochlear nerve arises from the back of the midbrain, and the abducent nerve arises below the pons.

04.39

The bony opening that these three nerves pass through is the superior orbital fissure, but their openings in the dura quite a bit further back. The oculomotor nerve passes through the dura just alongside the posterior clinoid process, which is here. The trochlear nerve passes through the dura here, the abducent nerve down here.

05.06

To follow them we'll remove the dura over this area. We'll also remove this structure that we'll see later, the trigeminal ganglion.

05.17

This cavity that we've opened into is the cavernous sinus. In the living living body it's filled with venous blood. Within the cavernous sinus lies the internal carotid artery.

05.35

The third, fourth and sixth nerves pass forward in the lateral wall of the cavernous sinus. Here's the oculomotor, here's the trochlear, here's the abducent. All three nerves pass forward into the orbit through the superior orbital fissure, which is here.

05.54

The seven muscles in the orbit that these nerves supply are the four rectus muscles, the two oblique muscles, and the levator of the upper eyelid. The oculomotor nerve supplies five muscles, the trochlear and abducent nerves supply just one muscle each.

06.12

To follow these nerves we'll move forward to the orbit again. We'll divide and displace the two muscles in the roof of the orbit. These are the levator of the upper eyelid, levator palpebrae superioris, and beneath it, the superior rectus muscle.

06.37

Here's the optic nerve, as we've seen already. Here's the superior oblique muscle, going round its pulley or trochlea. Here are the medial rectus, and lateral rectus muscles.

06.54

We'll go round to a front view to see the nerves better. The oculomotor nerve divides into an upper and lower branch.

07.03

Here's the upper branch, supplying the levator palpebrae superioris and superior rectus muscles. To see the lower branch we'll remove the optic nerve. Here again are the medial and lateral rectus muscles, down here is the inferior rectus.

07.25

The only muscle not on view here is the inferior oblique, which is beneath the eyeball here. Here's the lower branch of the oculomotor nerve. It supplies the medial rectus and inferior rectus, and the inferior oblique muscles.

07.44

In addition, by these tiny short ciliary branches, the oculomotor nerve gives parasympathetic motor supply to muscles within the eye that cause constriction of the pupil: the sphincter pupillae and ciliary muscles.

08.00

Here's the trochlear nerve, the fourth cranial nerve. It supplies just the superior oblique muscle. Here's the abducent nerve, the sixth, supplying its one muscle, the lateral rectus, which abducts the eye.

08.19

We'll be returning to the orbit once again in just a minute, to look at branches of the fifth nerve, the trigeminal. For now we'll replace the contents of the orbit, including this nerve, the frontal nerve, which is part of what we'll come to next.

08.40

Now we'll move on, to look at the fifth cranial nerve, the trigeminal. It's the largest of the cranial nerves, and by far the most complex. It's named from the fact that it has three major branches, the ophthalmic, the maxillary and the mandibular. The main functions of the trigeminal nerve are to provide sensation to the face, the nasal cavity and the oral cavity, and to provide motor supply to the muscles of mastication.

09.08

As we saw in the last section, the trigeminal nerve emerges from the pons, and passes forwards. To follow it we'll go to an earlier stage of the dissection that we've been looking at. The trigeminal nerve passes forwards from the pons into a tunnel in the dura. The tunnel leads into a side cavity, the trigeminal cave, which we'll expose by removing the overlying dura.

09.35

Here's the trunk of the nerve. Here are its three branches: the ophthalmic, the maxillary, and the mandibular. All the sensory fibers of the trigeminal nerve synapse in this massive ganglion, the trigeminal ganglion. In relation to the dry bone, the trigeminal gangion is here.

10.03

The openings for the three branches are the superior orbital fissure for the ophthalmic, the foramen rotundum for the maxillary, and the foramen ovale for the mandibular.

10.14

The first branch of the trigeminal, the ophthalmic nerve, passes forwards through the superior orbital fissure. As it does so it divides. It gives off the frontal nerve which runs just beneath the roof of the orbit, and divides into cutanous branches which go to the forehead.

10.35

In addition the ophthalmic nerve gives rise to the lacrimal nerve, which supplies the lacrimal gland, and the nasociliary nerve, which gives off one or more ethmoidal nerves and a cutaneous branch, the infratrochlear nerve. Through two long ciliary nerves (here's one of them), the nasociliary nerve provides sensation to the eyeball,

11.07

The branches of the frontal nerve that we saw, emerge onto the face around the orbital margin, or through openings in it. The branches of the frontal nerve are the supra-orbital, the supratrochlear, and the infratrochlear.

11.27

Through these branches the ophthalmic nerve supplies the forehead, the upper eyelid, and the upper part of the nose. The ethmoid branches of the nasociliary nerve supply this part of the lining of the nasal cavity.

11.40

Now we'll move on to look at the second and third divisions of the trigeminal, the maxillary and mandibular nerves. Before we look at these two nerves, which are both quite complex, we'll spend a minute reviewing the region into which they emerge. It's a little complex too. To see it, we'll first look at a dry skull in which the zygomatic arch has been removed.

12.05

Here's the area we'll be looking at. Here's the underside of the greater wing of the sphenoid bone, here's the lateral pterygoid plate, here's the back of the maxilla. This gap between the pterygoid process and the maxilla is the pterygo-maxillary fissure. It's continuous with this gap between the maxilla and the greater wing of the sphenoid, the inferior orbital fissure. Here's the inferior orbital fissure seen from in front.

12.36

The maxillary nerve emerges here, deep in the pterygo-maxillary fissure. The mandibular nerve emerges here, behind the lateral pterygoid plate .

12.47

To get to this remote area in a dissected specimen we have to remove several major structures: first the masseter muscle, then the deep temporal fascia, then the zygomatic arch, and then the temporalis muscle, and the ramus and coronoid process of the mandible, and finally this muscle, the lateral pterygoid, together with the condyle of the mandible.

13.28

This brings us into the infratempral fossa. Before we look at the nerves, let's get oriented. Heres the underside of the greater wing of the sphenoid, here's the lateral pterygoid plate, the back of the maxilla, the pterygo-maxillary fissure, and the superior orbital fissure.

13.51

This is the medial pterygoid muscle. It slopes downwards and outwards towards its insertion on the medial aspect of the mandible. This muscle is the buccinator.

14.05

Now that we're oriented, let's look at the maxillary nerve. As we've seen, seen, the maxillary nerve runs forwards from the trigeminal ganglion, and enters the foramen rotundum, which is here.

14.20

Here's the foramen rotundum in the dry bone. We'll go round to the outside to see where it emerges. Here it is, well hidden in the pterygo-maxillary fissure. The foramen rotundum goes out of sight as we go round to a lateral view of the pterygo-maxillary fisure. Now we'll return to the dissection.

14.44

Here's the maxillary nerve, running forwards across the pterygo-maxillary fissure. As it approaches the maxilla it divides into branches. The continuing trunk of the nerve is known as the infra-orbital nerve. We'll follow it first.

15.02

The infra-orbital nerve runs forward into a bony tunnel in the floor of the orbit. It emerges again here, at the infra-orbital foramen. The infra-orbital nerve divides into palpebral, labial and nasal branches. These supply the lower eyelid, part of the nose and cheek, and the upper lip.

15.27

The branches of the maxillary nerve supply the upper teeth, the nasal cavity and palate, and the upper part of the cheek. Most of them run through tunnels in the bone. Because of this, and because they're small, they're hard to show in a dissection. To indicate where they run, we'll add lines to the picture.

15.49

The upper teeth are supplied by the superior alveolar nerves, posterior and anterior, which together form a loop.

15.16

The posterior superior alveolar nerves (in this case there are two) branch off behind the maxilla, and run down to enter tunnels in the maxilla here. The anterior superior alveolar nerve arises from the infra-orbital nerve within its tunnel, and runs downwards and forwards within the bone.

16.22

The superior alveolar nerves, anterior, and posterior, form a loop within the maxilla. From this loop dental and gingival branches arise that supply the upper teeth, and the upper gums.

16.38

The maxillary nerve also gives off palatine and nasopalatine branches that supply the palate, and parts of the nasal cavity. To see where these go we'll look at a skull that's been divided in the mid-line. The opening that's illuminated is the sphenopalatine foramen, which opens into the pterygo-maxillary fissure. The maxillary nerve enters the fissure from behind, here.

17.07

Two palatine nerves, the greater and lesser, arise from the maxillary nerve and run down through a bony tunnel that's been partly opened here. The palatine nerves emerge here, through the palatine foramen. The palatine nerves provide sensation to the palate from here to here.

17.38

In addition the greater palatine nerve has nasal branches. Together with nasal branches from the trunk of the maxillary nerve, these supply this part of the lining of the nasal cavity.

17.51

The nasopalatine nerve passes through the sphenopalatine foramen, round the front of the sphenoid sinus, and onto the nasal septum. The nasopalatine nerve supplies the nasal septum, then passes through the incisive foramen, in the maxilla, to supply the anterior part of the hard palate.

18.17

Last of all, the maxillary nerve gives off a zygomatic branch. This divides into the zygomatico-facial and zygomatico-temporal nerves. These pass through the zygomatic bone, emerging here, to supply this part of the cheek.

18.35

Now we'll move on to look at the third division of the trigeminal, the mandibular nerve. Here's the mandibular nerve leaving the trigeminal ganglion. The mandibular nerve passes downward through the foramen ovale. The foramen ovale emerges under here. The foramen is just behind the root of the lateral pterygoid plate.

19.04

Returning to the dissection, here's the mandibular nerve, branching as it emerges from the foramen ovale. The mandibular nerve has both motor and sensory branches. Its motor branches (here they are) go to the muscles of mastication: masseter, temporalis, and the pterygoid muscles. Small branches, not seen here, supply tensor tympani and tensor palati.

19.35

The other branches of the mandibular nerve are almost entirely sensory. This branch is the buccal nerve. It runs downwards and forwards to supply sensation to the cheek, both outside and inside.

19.45

This branch is the auriculo-temporal nerve. It passes deep to the neck of the mandible, which is here, then runs upwards to supply sensation to this region on the side of the head.

20.00

This leaves two major branches which run downward on the medial pterygoid muscle. They're the inferior alveolar nerve, and just in front of it, the lingual nerve.

20.12

Seen from the inside, the lingual nerve is here, the inferior alveolar nerve is here. The insertion of the medial pterygoid muscle is here. The inferior alveolar nerve follows the medial pterygoid muscle down toward the mandible.

20.31

It enters the mandible through this opening, the mandibular foramen. As it enters the bone, the inferior alveolar nerve lies just behind this projection, the lingula. To follow the course of the inferior alveolar nerve in the mandible, we'll remove the overlying bone.

20.56

Here's the inferior alveolar nerve entering its tunnel in the bone, the mandibular canal. Just before it does so it gives off this mylohyoid branch, which runs downwards in this groove to supply the mylohyoid muscle and the anterior belly of the digastric.

21.15

Passing along the mandibular canal, the inferior alveolar nerve gives off branches that supply the lower teeth and gums. A large branch, the mental nerve, emerges through the mental foramen, which is here. The mental nerve supplies the chin and the lower lip.

21.38

Now we'll look at the lingual nerve. To follow it, we'll first remove the inferior alveolar nerve, and the buccinator muscle. This brings us into the oral cavity. The lingual nerve passes close to the mandible. To follow its course, we'll remove this part of the mandible.

22.01

We'll also remove the mucosa from the side of the tongue, and the floor of the mouth. Here's the lingual nerve. Now that we can see it all, we'll follow it from the top.

22.16

Up here the divided stump of the inferior alveolar nerve has been displaced forward so that we can see an important detail. Early in its course the lingual nerve is joined by this nerve, the chorda tympani, which is a special branch of the facial nerve. The lingual nerve runs down toward the corner of the medial pterygoid muscle, passing just medial to the buttress of the mandible.

22.43

The lingual nerve passes forwards along the base of the tongue, giving off branches along its length. The lingual nerve provides common sensation, and also taste sensation, to the anterior two-thirds of the tongue. The taste fibers that travel in the lingual nerve are carried by the chorda tympani.

23.02

Now we've looked at the first six cranial nerves. Let's review what we've seen so far in this section.

23.10

REVIEW

Here are the filaments of the first cranial nerve, the olfactory, here's the second cranial nerve, the optic.

23.23

Here's the third nerve , the oculomotor: its upper division, and its lower division. Here's the fourth nerve, the trochlear, and here, out of order, is the sixth, the abducent

23.37

Here's the trigeminal nerve: the main trunk, the trigeminal ganglion, and the three divisions: the ophthalmic, the maxillary, and the mandibular. Here are the main branches of the ophthalmic: the frontal nerve, the nasociliary nerve, the lacrimal nerve.

24.01

The main branches of the maxillary: the infra-orbital, the posterior, and anterior superior alveolar; the palatine nerves, greater and lesser, the nasopalatine nerve, and the zygomatico-facial, and zygomatico-temporal nerves.

24.24

Here are the main branches of the mandibular nerve: the buccal nerve, the motor branches, the auriculo-temporal nerve, the lingual nerve, and the inferior alveolar nerve.

24.38

CRANIAL NERVES VII - XII

We'll move on now to look at cranial nerves seven through twelve. We'll begin with the seventh and eighth, the facial and vestibulo-cochlear nerves. As we've seen, these two nerves leave the brainstem just below the pons. Here's the facial, here's the vestibulo-cochlear.

25.05

To follow them we'll look at a dissection of the posterior cranial fossa, in which the cerebellum has been removed. Here's the back of the petrous temporal bone. Here are the facial and vestibulo-cochlear nerves. This is the vestibulo-cochlear nerve, this is the facial nerve. Together they pass through this opening, the internal auditory meatus.

25.31

Here's the internal auditory meatus in the dry skull. It's a short tunnel with three openings. The facial nerve passes forwards through this one, to enter its own bony tunnel, the facial canal. In the facial canal, the facial nerve has a complex course in the temporal bone, passing round the wall of the tympanic cavity, and coming out behind the styloid process, here.

26.05

To get a view of its course we've we've removed the front wall of the external auditory meatus along this line. We've also unroofed a small part of the petrous temporal bone, here. To represent the facial nerve we'll add this green wire to the picture.

26.29

Entering its canal the facial nerve passes forward briefly, then makes an abrupt U-turn called the genu and passes backward. To follow it we'll come round to the outside and look into the tympanic cavity.

26.49

The facial nerve passes backwards high in the medial wall of the tympanic cavity, above the oval window. It then turns downwards, to emerge here at the stylomastoid foramen, just behind the root of the styloid process.

27.03

On its way through the temporal bone the facial nerve gives off three branches, the greater petrosal nerve which is an autonomic branch, a branch in the middle ear to the stapedius muscle, and a special branch, the chorda tympani, represented by by this wire. The chorda tympani passes upwards on the inside of the tympanic membrane, and leaves the cranium here to join the lingual nerve.

27.35

Weve seen already that the chorda tympani transmits taste sensation from the anterior two thirds of the tongue. Now we'll follow the trunk of the facial nerve.

27.45

As we saw in the previous tape, the facial nerve passes through the parotid gland. In the dissection we'll look at now, the parotid gland gland has been completely removed. Here's the external auditory meatus, the sternocleidomastoid muscle, and the posterior belly of the digastric. Here's the styloid process.

28.08

Here's the trunk of the facial nerve, emerging from the stylomastoid foramen here. Now we'll add its branches to the picture. Between them they supply all the muscles of facial expression.

28.23

These temporal branches supply the frontalis muscle. These orbital branches supply the muscles around the eye, including orbicularis oculi. These buccal branches supply buccinator, orbicularis oris, and the muscles that move the upper lip.

28.44

These marginal mandibular branches, which pass just below the body of the mandible, supply the muscles that move the lower lip. They also supply the platysma.

28.58

In addition to supplying the muscles of facial expression the facial nerve gives this branch that supplies the posterior belly of the digastric, and the stylohyoid muscle.

29.08

Now that we've looked at the facial nerve, we'll look very briefly at the eighth cranial nerve, the vestibulo-cochlear. The vesstibulo-cochlear nerve enters the internal auditory meatus, dividing as it does so into the vestibular and cochlear nerves.

29.27

The vestibular nerve passes through this opening into the inner ear, the cochlear nerve passes through this one. The two nerves transmit our senses of balance and hearing respectively.

29.39

Let's move on to look at the last four cranial nerves. They're the glossopharyngeal, number nine, the vagus, number ten, the accessory, number eleven, and the hypoglossal, number twelve. These four nerves leave the skull close together.

29.58

Here are the ninth, tenth and eleventh nerves. The ninth and tenth nerves arise from a line of filaments that emerge from the lateral aspect of the medulla.

30.12

Here's the glossopharyngeal nerve, the ninth cranial nerve. It's quite small. Below it is the vagus, the tenth nerve, arising by one large root, and a line of smaller ones that emerge from the medulla all the way down to here.

30.28

Below the vagus, is the accessory nerve. Its full name is the spinal accessory. It arises from a procession of filaments that emerge from the spinal cord from C1 as far down as C5. The spinal accessory runs upwards through the foramen magnum to join the ninth and tenth nerves.

30.50

The hypoglossal nerve, the twelfth cranial nerve, arises more anteriorly. Here are its filaments converging. The hypoglossal nerve passes through the dura by itself, the ninth, tenth and eleventh nerves pass through the dura together to enter the jugular foramen.

31.10

Nerves nine, ten and eleven leave through this part of the jugular foramen. The hypoglossal nerve leaves through this opening, the hypoglossal canal.

31.23

We'll go round to the outside of the skull to see where the nerves emerge. Here's the jugular foramen, with the hypoglossal canal opening just in front of it. Nerves IX, X and XI emerge through this part of the jugular foramen.

31.46

Here are the four nerves emerging in front of the upper end of the internal jugular vein. Here's the internal carotid artery, the styloid process was here.

31.58

Here's the glossopharyngeal nerve, here's the vagus, here's the accessory, here's the hypoglossal. To get this view we've removed the styloid process and its muscles, the posterior belly of the digastric muscle, and the ramus of the mandible, as we did in the last section.

32.22

We'll follow these four nerves one at a time, adding or removing the overlying structures as we progress.

32.29

The small glossopharyngeal nerve - this is it - is mainly a sensory nerve. It runs lateral to the internal carotid artery, then passes downward and forward through or lateral to the stylopharyngeus muscle, which it supplies. The glossopharyngeal nerve enters the wall of the pharynx here, between the superior and middle constrictor muscles.

32.58

The glossopharyngeal nerve provides sensation, including taste, to the posterior third of the tongue, and also sensation to the back of the oral cavity and the oropharynx.

33.08

Now we'll move on to look at the vagus nerve. Its name means wandering: it goes all the way to the abdomen. The principal role of the vagus is to provide parasympathetic supply to organs throughout the thorax and upper abdomen. It also gives sensory and motor supply to the pharynx and larynx.

33.30

To see the upper end of the vagus we'll take this nerve, the hypoglossal, out of the picture for now. Here's the vagus. Its trunk is thickened by this ganglion, the lower of two.

33.48

To follow the vagus in its course down the neck we'll move the internal jugular vein aside. The vagus runs down the neck with the internal jugular vein behind it, and the internal and common carotid arteries in front of it, all the way down to the superior thoracic aperture. The clavicles have been removed in this dissection: here's where they were. Here's the first rib.

34.15

The vagus continues down into the thorax: its further course is shown in Tape 3 of this Atlas. The vagus nerve has important branches in the neck. We'll remove the common and internal carotid arteries to see them.

34.29

High in the neck the vagus gives off a pharyngeal branch or branches, and this large branch, the superior laryngeal nerve. Right down in the thorax the vagus also gives off the important recurrent laryngeal nerve: we'll come to it in a minute.

34.48

The pharyngeal branch or branches of the vagus enter the wall of the pharynx. They supply the superior and middle constictor muscles, and all the muscles of the palate except the tensor palati.

35.01

The superior laryngeal nerve passes downwards and forwards towards the hypopharynx. We'll follow the superior nerve in another dissection. The hyoid bone is here, the thyroid cartilage is here.

35.19

The superior laryngeal nerve - here it is - divides into an external branch, and an internal branch. The internal branch enters the wall of the hypopharynx by passing through the thyrohyoid membrane here. It provides sensation to the hypopharynx, the epiglottis, and the part of the larynx that lies above the vocal folds. The external branch gives motor supply to the cricothyroid muscle and the inferior constrictor muscle.

35.52

Now we'll look at the recurrent laryngeal nerve. To see it we'll go to a different dissection in which the internal jugular vein, which was here, has been removed. Here's the common carotid artery, here's the vagus.

36.10

Down here the vagus passes in front of the subclavian artery. As it does so it gives off the recurrent laryngeal nerve. As we saw in Tape 3, the recurrent laryngeal nerve goes round the subclavian artery on the right, and round the arch of the aorta on the left.

36.31

To see the recurrent laryngeal nerve in this dissection, we'll remove the common carotid artery. Here's the recurrent laryngeal nerve. It runs upwards and medially alongside the trachea, and passes behind the lower pole of the thyroid gland.

36.51

To follow its course we'll remove the thyroid gland, and the infrahyoid muscles. Here's the upper end of the trachea, joining the cricoid cartilage, which is here. This is the cricothyroid muscle. Here's the recurrent laryngeal nerve. It runs upwards and reaches the larynx here, behind the arch of the cricoid cartilage.

37.16

In its upward course it crosses the branches of the inferior thyroid artery, or runs between them, as in this case. The recurrent laryngeal nerve gives motor supply to all the muscles of the larynx, except the cricothyroid. It also provides sensation to the larynx below the vocal folds.

37.35

Let's move on, to look at the eleventh cranial nerve, the accessory. It's a motor nerve, supplying just two muscles. The spinal accessory nerve passes around the upper end of the internal jugular vein, then passes downward and backward behind the posterior belly of the digastric. It runs beneath the sternocleidomastoid muscle, which we'll add to the picture. The spinal accessory supplies the sternocleidomastoid muscle, sometimes running deep to it, sometimes through it.

38.16

Emerging near the posterior border of the sternocleidomastoid, the spinal accessory nerve runs downward and backward across the splenius muscle, and passes beneath the other muscle that it supplies, the trapezius.

38.28

Lastly we'll look at the twelfth cranial nerve, the hypoglossal. It's a motor nerve, supplying all the muscles of the tongue, and partly supplying the infrahyoid muscles.

38.41

The hypoglossal nerve emerges between the internal carotid artery and internal jugular vein. It runs downward and forward across the external carotid artery.

38.56

We've added the styloglossus muscle to the picture here. Missing from the picture are the stylohyoid muscle, and the posterior belly of the digastric.

39.05

The hypoglossal nerve gives off this descending branch, then turns and runs forward. It runs just below the styloglossus muscle, and passes forward into the gap between hyoglossus medially, and the mylohyoid muscle laterally: the same gap that the lingual nerve runs in. The hypoglossal nerve supplies all the muscles of the tongue including the intrinsic muscles, and also the geniohyoid muscle.

39.32

To look at the descending branch of the hypoglossal nerve, we'll go further down the neck. Here's the descending branch of the hypoglossal nerve. Its fibers in fact come from C1. It passes downwards and forwards in front of the internal jugular vein. It's joined by this branch from C2 and 3 to form a loop, called the ansa cervicalis. The branches that arise from the ansa cervicalis provide the motor supply to all four of the infrahyoid muscles.

40.09

In looking at the twelve cranial nerves we've concentrated on the main aspects of each nerve and omitted many of the smaller branches and cross-connections. We've also left out of the picture the complex autonomic nerve supply to the head and neck. The details of both the sympathetic and parasympathetic systems in the region are too small to be shown clearly in straightforward dissections. They're more readily understood from diagrams, to which I'm sure have access.

40.39

To end this section we'll look at the one part of the autonomic system that is clearly visible: the sympathetic trunk. We'll also look briefly at the cervical nerves.

40.50

To see the sympathetic trunk, we've removed all the cranial nerves, and the internal jugular vein. We'll also move the common and internal carotid arteries aside. Here's the cervical sympathetic trunk. It runs up the neck on the fascia that lies in front of the longus muscles.

41.16

This massive thickening at the top of the sympathetic trunk is the superior cervical ganglion. From its upper end this nerve, the internal carotid nerve arises, and joins the internal carotid artery as it enters the carotid canal.

41.33

Now we'll move on to look at the cervical plexus. To see it, we'll look at a dissection in which only the skin and subcutaneous tissue have been removed.

41.45

Here's the cervical plexus. It's formed from the anterior roots of C1, 2, 3 and 4. These emerge in front of the middle scalene muscle. Most of the branches of the plexus run laterally, this one runs straight downward: its the phrenic nerve.

42.07

The phrenic nerve runs downwards into the thorax on the front of the anterior scalene muscle, to innervate the diaphragm.

42.14

Many of the branches of the cervical plexus emerge here, around the posterior border of the sternocleidomastoid muscle. These are the supraclavicular nerves, which pass downward and laterally to supply the upper chest and shoulder region.

42.34

This is the great auricular nerve, which supplies this area on the side of the face. This is the posterior auricular, which supplies this area.

42.44

Here just beneath the sternocleidomastoid is the lesser occipital nerve. Here more posteriorly, is the greater occipital nerve, arising from the posterior root of C2. The occipital nerves supply this area on the back of the scalp.

43.06

Now, let's review what we've seen in the second half of this section on the nerves of the head and neck.

43.13

REVIEW

Here's the facial nerve inside, and outside the skull, with its frontal, orbital, buccal and marginal mandibular branches. Here's the vestibulo-cochlear nerve. Here's the glossopharyngeal nerve on the inside, and on the outside.

43.41

Here are the roots of the vagus, here's the vagus emerging. Here are its pharyngeal, superior laryngeal, and recurrent laryngeal branches. Here's the spinal accessory nerve, inside, and outside.

44.01

Here's the hypoglossal. Here it is again, here's its descending branch, here's the ansacervicalis. Here's the sympathetic trunk. Here's the phrenic nerve

44.16

Here are the supraclavicular, great auricular, posterior auricular, lesser occipital, and greater occipital nerves.

44.29

That brings us to the end of this section on the nerves. In the next section we'll look at the blood vessels of the head and neck.

44.43

END OF PART 3

PART 4

THE BLOOD VESSELS OF THE HEAD AND NECK

00.00

In this section we'll look at the arteries and veins of the head and neck. First we'll look at the two major arteries that supply the region. Then we'll look at the blood vessels inside the cranial cavity, then at the ones outside it.

00.23

MAJOR ARTERIES

On each side two major arteries, the common carotid and the subclavian, emerge through the opening at the top of the chest, the superior thoracic aperture. To see them we'll look look at a dissection in which we've already removed the overlying structures: the sternocleidomastoid muscle, the infrahyoid muscles, and the internal jugular vein. Here's the clavicle, the first rib is here.

00.54

This is the anterior scalene muscle. Here's the trachea, here's the thyroid gland. Here are the common carotid and subclavian arteries, coming up through the superior thoracic aperture. As seen in Tape 3, these arise from the arch of the aorta, the two on the left directly, the two on the right indirectly from the brachiocephalic artery. We'll look at the subclavian artery first.

01.24

On each side the subclavian artery passes upward and laterally, giving off these branches which we'll see in a moment. It then passes behind this muscle, the anterior scalene, crossing the underlying first rib as it does so. Emerging here, it runs down beneath the clavicle towards the axilla to supply the upper extremity.

01.48

The branches that arise from the subclavian artery in the base of the neck are the internal thoracic, the thyro-cervical trunk, which we'll remove, and this important branch, the vertebral artery, which we'll come back to shortly.

02.08

We'll leave the subclavian artery for now, and follow the common carotid artery. The common carotid artery runs upward lateral to the thyroid gland, the trachea and the larynx. A little below the level of the angle of the mandible, which is here, the common carotid divides into the external, and internal carotid arteries.

02.33

To see these more clearly we'll take the parotid gland, and the ramus of the mandible out of the picture. At the bifurcation of the common carotid, which is better seen in this more typical specimen, there's a widening, the carotid sinus. Usually the internal carotid artery runs almost straight upward, but in this dissection, the one we'll be following, it takes quite a forward curve.

02.59

The branches of the external carotid arteries supply the skull, the dura, and all of the head outside the cranial cavity, apart from the orbit. The brain is supplied by the internal carotid arteries and the vertebral arteries. We'll move on now, to follow those arteries into the cranium, and look at their branches.

03.22

INTRACRANIAL ARTERIES

To follow the internal carotid artery we'll take the external carotid and its branches out of the picture. We'll also remove the posterior belly of the digastric, the styloid process, and the muscles that arise from it.

03.39

The internal carotid artery runs upwards to the base of the skull without branching. The internal jugular vein is lateral to it, here. The internal carotid artery enters the carotid canal which is here in the dry skull.

03.57

The carotid canal immediately turns, to run forwards and medially. To see the other end of the carotid canal we'll go all the way round to the inside. The carotid canal comes from this direction and ends here at the foramen lacerum.

04.17

To expose the internal carotid artery we'll first remove the dura of the middle cranial fossa, then we'll remove this structure, the trigeminal ganglion, and finally these three cranial nerves: the third, fourth, and sixth. Here's the internal carotid artery coming up out of the foramen lacerum.

04.44

The internal carotid artery here lies within an irregular cavity, the cavernous sinus, that's a passageway for venous blood. We'll see it later in this section. The artery turns to run forwards, then makes a complete 180º turn. This turn takes it under the anterior clinoid process, and brings it out here, just below and behind the optic canal.

05.17

The internal carotid artery finally emerges through the dura just beneath the optic nerve. As it completes its backward turn, it gives off a branch, the ophthalmic artery. To see that, we'll remove the optic nerve, and the dura beneath it.

05.35

Here's the start of the ophthalmic artery. It runs forwards into the optic canal along with the optic nerve. The ophthalmic artery supplies the contents of the orbit and continues forward to supply the central part of the forehead.

05.50

To see how the internal carotid artery ends we'll add its last part, and the optic chiasm to the picture. The internal carotid artery ends by emerging from beneath the chiasm, curving laterally as it does so. We'll follow its branches in a minute.

06.08

Now we'll follow the course of the other major artery to the brain, the vertebral artery. As we've seen, seen, the vertebral artery arises from the subclavian artery in the root of the neck. It runs straight upwards, and disappears to pass through the opening in the transverse process of the sixth cervical vertebra.

06.28

To follow its course we'll remove all the neck muscles, and the tissues between the transverse processes. The vertebral artery runs upwards through the transverse processes of the upper six cervical vertebrae. Here's the vertebral artery. The two vertebral arteries pass through these openings in each vertebra.

06.55

After passing through the transverse process of the atlas it turns backwards, and then medially, to pass through the atlanto-occipital membrane and the dura, just below the foramen magnum, which is here.

07.09

To follow the vertebral artery we'll divide the cranium along this line, and remove the brain. Here are the two vertebral arteries passing through the dura. The vertebral arteries join together, forming this large artery, the basilar artery, which runs upwards and forwards above and behind the basilar part of the occipital bone.

07.38

Now that we've followed the internal carotid and vertebral arteries into the cranial cavity we'll see how they supply the brain. We'll also see the set of arterial connections known as the arterial circle, or circle of Willis.

07.51

So far we've seen, seen the internal carotids entering up here, the vertebral arteries entering down here and joining to form the basilar artery. Now we'll complete the picture.

08.06

To name the vessls we're looking at, we'll start with the main branches of the internal carotid. The internal carotid gives off the anterior cerebral, and posterior communicating arteries, then continues with a different name: from here the vessel is called the middle cerebral artery.

08.34

The two anterior cerebral arteries curve towards each other above the chiasm, then pass upwards and forwards close together to enter the longitudinal cerebral fissure between the two cerebral hemispheres.

08.50

Just above the optic chiasm, the two anterior cerebral arteries are connected to each other by this very short anterior commumicating artery, which is part of the arterial circle.

09.05

The middle cerebral artery, which is the direct continuation of the internal carotid, curves laterally. It enters the lateral cerebral fissure between the frontal and temporal lobes. We'll follow it there shortly. The pale areas on this artery are patches of atheroma.

09.28

Now we'll go round to a view from behind, to see the vertebral and basilar arteries, and the vessels that arise from them. Here are the two vertebral arteries, joining together to form the basilar artery.

09.47

Down here four inferior cerebellar arteries usually arise, two posterior and two anterior. These are the posterior ones. In this specimen the anterior ones are represented by this one vessel. In addition the basilar artery gives off small branches to the pons, and this labyrinthine artery that supplies the inner ear.

10.10

Four branches arise from the top of the basilar artery, these two superior cerebellar arteries, and the two terminal branches of the basilar, the posterior cerebral arteries.

10.23

The posterior cerebral artery curves backwards and laterally above this nerve, the oculomotor. It curls around the cerebral peduncle. We'll look at its course in a few minutes. Just as it turns, the posterior cerebral artery is joined by this small artery that we've seen already: the posterior communicating artery.

10.47

The posterior communicating artery completes the arterial circle. The arterial circle provides connections between the right and left sides, and also connects the vertebral and internal carotid systems. It's more of a hexagon than a circle.

11.05

Its component parts, from front to back, are the anterior communicating artery, the anterior cerebral arteries, the internal carotids, the posterior communicating arteries, and the posterior cerebral arteries. The arrangement is often somewhat asymmetrical: here, the left posterior communicating artery is very small.

11.29

The vessels we're looking at lie in the confined space between the floor of the cranial cavity and the underside of the brain. To see how they're related to the brain, we'll look at a brain that's been removed from the body together with its arteries. The arteries have been filled with red latex.

11.50

Over this area, the arachnoid layer and the many small vessels in it have been removed, so that we can see the major arteries. Here's the optic chiasm, here beneath it are the divided ands of the internal carotid arteries.

12.04

Here's the the anterior cerebral artery, passing around the optic chiasm, which we'll pull downwards. Here's the anterior communicating artery. The two anterior cerebral arteries turn upwards to enter the longitudinal cerebral fissure. We'll follow them shortly.

12.26

The internal carotid, which we'll go back to, gives off the posterior communicating artery, then continues, to become the middle cerebral artery. The middle cerebral artery enters the lateral cerebral fissure, between the frontal and temporal lobes of the cerebral hemisphere.

12.52

Coming from below, here are the two vertebral arteries joining to form the basilar artery, which is quite off-center in this specimen. Here are three of the possible four inferior cerebellar arteries, here are the two superior cerebellar arteries. Here's the division of the basilar, into the two posterior cerebral arteries.

13.10

To follow the course of the anterior, middle and posterior cerebral arteies, we'll divide the brain in the midline and look at just one cerebral hemisphere.

13.24

Each anterior cerebral artery runs upwards and then backwards close to the corpus callosum. It gives off branches which supply this area on the medial aspect of the cerebral hemisphere, and which then reach over the superior margin of the hemisphere, to supply this area on the lateral aspect.

13.48

Next we'll follow the middle cerebral artery. Here it is again, running in the depths of the lateral cerebral fissure. The middle cerebral artery gives off branches which emerge along the length of the lateral cerebral fissure to supply this area on the lateral aspect of the cerebral hemisphere.

14.16

Lastly we'll follow the posterior cerebral artery. It runs laterally just above this nerve, the oculomotor, then runs backward, passing around the cerebral peduncle. To follow it we'll again look at the cerebral hemisphere hemisphere by itself.

14.36

Here's the posterior cerebral artery. It winds around between the cerebral peduncle, which has been divided here, and the most medial part of the temporal lobe.

14.51

The posterior cerebral artery gives off branches which supply this area on the medial aspect and underside of the hemisphere, and this [area] on the lateral aspect.

15.08

INTRACRANIAL VEINS AND VENOUS SINUSES

Now that we've seen the principal arteries of the the brain, we'll move on to look at its veins, and at the channels that its veins drain into, the venous sinuses.

15.18

The brain is richly covered with veins. Over the surface of the cerebral hemispheres, the veins emerge from the sulci, join with one another, and run upwards within the arachnoid layer. Here behind the midbrain veins converge from many directions to form this great cerebral vein. We'll see where that goes shortly.

14.42

These veins drain into the venous sinuses which are a special feature of the cranial cavity. We'll look at these next. The sinuses that drain almost all the blood from the brain are the two sagittal sinuses, the straight sinus, and the two transverse sinuses. These sinuses are closely related to the major folds in the dura that we that we saw in an earlier section: the falx, and the tentorium.

16.11

In this specimen there are some openings in the falx, which is not unusual. The two sagittal sinuses run the length of the falx. The smaller inferior sagittal sinus runs within its free border, the larger superior sagittal sinus within its attached border. Blood in both the sagittal sinuses flows from front to back.

16.34

Here we've removed one side of the superior sagittal sinus so that we can look into it. As we saw in a previous section, the superior sagittal sinus is contained in a triangular space that's enclosed on all three sides by dura. At several places side passages called lacunae open into the sinus.

16.57

Veins from the surface of the brain open into the lacunae. The superior sagittal sinus ends where the attachments of the falx and the tentorium meet. Also running toward the same point is the straight sinus, which we'll lay open.

17.12

The straight sinus runs along the junction between the falx and the tentorium. At its upper end the it receives the inferior sagittal sinus, and also the great cerebral vein.

17.27

Here there's a major joining and branching of sinuses called the confluence of sinuses. We'll look at it in a different dissection of just the back of the head. The confluence of the sinuses is here. To see it we'll remove the falx and the tentorium, leaving just their lines of attachment. Here's the confluence laid open. Leading from it on each side are the two major outflow channels for venous blood, the transverse sinuses.

18.05

Each transverse sinus runs within the attached border of the tentorium. Starting here in the mid-line, the transverse sinus follows the attachment of the tentorium round to here, then continues by turning sharply downwards in this s-shaped groove just behind the petrous temporal bone.

18.24

The sinus goes by two different names: this part is the transverse sinus, this part is the sigmoid sinus. To follow the sigmoid sinus we'll look at a different skull. Here's the groove for right sigmoid sinus. Here's the groove for the left one. They're usually unequal in size.

18.45

The sigmoid sinus leaves the cranial cavity by passing through this irregular opening, the jugular foramen, along with three cranial nerves that we saw in the previous section. Here we're looking into the posterior cranial fossa from behind. The cerebellum has been removed. We'll remove the dura that covers the sigmoid sinus.

19.08

Within the jugular foramen the end of the sigmoid sinus turns sharply downwards, becoming continuous with the the internal jugular vein.

19.18

As we'll see in a minute, there are also venous sinuses that drain the base of the skull. Before we see them, we need to go back to the superior sagittal sinus, and look at the structures on each side of it that absorb cerebrospinal fluid.

19.33

These structures, the arachnoid granulations, were left out of the picture in the earlier section on the brain. To see them we'll return to this view of the surface of the brain. This central strip of dura contains the superior saggital sinus. We'll remove the dura that forms the roof of the sinus.

19.52

These small projections in the floor of the sinus, and on its sides, are arachnoid granulations. They're upward protrusions of the arachnoid membrane. At their surface, cerebrospinal fluid from the subarachnoid space is transferred back into the bloodstream.

20.16

Now we'll complete our picture of the venous sinuses by looking at the ones that drain the base of the skull. The most important of these are the two cavernous sinuses, one on each side.

20.28

We saw this view of the cavernous sinus when we looked at the internal carotid artery. The cavernous sinus is the space around the artery. It extends forwards to the superior orbital fissure, and backwards almost to the dorsum sellae. It's bounded medially by the dura that lines the pituitary fossa. As we've seen, the lateral wall of the cavernous sinus contains these three cranial nerves, the third, fourth and sixth.

20.59

Outside these lies the trigeminal ganglion, and outside that, the dura of the middle cranial fossa. To get a cross-sectional view of the cavernous sinus we'll go to a different specimen and divide it in the frontal plane along this line. This is the cavernous sinus. The big cavity in the midline is a sinus of a different order: it's the sphenoid sinus. Here's the divided internal carotid artery passing forwards.

21.41

Here are cranial nerves three, four and six. Here's the trigeminal ganglion, here's the dura. Here's the pituitary gland, contained within the dura that creates the pituitary fossa.

21.58

The two cavernous sinuses are connected to each other behind the pituitary gland. The cavernous sinus receives blood from several sources, including the superior orbital vein, a major vein from the orbit, which connects the cavernous sinus to veins in the upper part of the face.

22.19

The cavernous sinus drains into the two petrosal sinuses, superior and inferior, which have been exposed on the right side. The petrosal sinuses also receive veins from the cerebellum. They empty into the sigmoid sinus up here, and under here.

22.42

EXTRACRANIAL ARTERIES

Now we've finished looking at the intracranial blood vessels. We'll follow the internal jugular vein in a few minutes. Let's move on now, to look at the blood supply of the head and neck outside the cranial cavity. We'll look first at branches of the subclavian artery that make a contribution, then at the external carotid artery and its branches.

23.04

Here's the subclavian artery again. Here's the vertebral artery which we've seen already. Arising here in front of it is the thyro-cervical trunk, a short vessel that immediately divides, giving off these branches to the shoulder region, and the inferior thyroid artery.

23.28

The inferior thyroid artery gives off this small ascending cervical artery, then runs medially, deep to the common carotid artery, to reach the lower pole of the thyroid gland.

23.41

Now we'll go to a different dissection, to look at the external carotid artery and its branches. We've removed the sternocleidomastoid muscle, the internal jugular vein, and the parotid gland. Here's the common carotid artery, dividing into the internal carotid, and the external carotid.

24.06

The external carotid artery runs upward, passing beneath the posterior belly of the digastric muscle, and the stylohyoid muscle. It ends above the stylohyoid by dividing into its two terminal branches, which we'll see in a minute.

24.21

The first branch of the external carotid is the superior thyroid artery. It runs downwards alongside the larynx, to reach the upper pole of the thyroid gland.

24.33

The next branch is the lingual artery. It runs downwards and forwards, passing deep to the hyoglossus muscle, to supply the tongue. To see the remaining branches of the external carotid, we'll remove the posterior belly of the digastric, and the stylohyoid muscle.

24.55

This is the facial artery. The facial artery runs forwards, passing between the submandibular gland and the angle of the mandible, and emerging here. The facial artery crosses the mandible (it's extremely tortuous in this specimen) and runs upwards and forwards, branching to supply the lower part of the face.

25.25

Here, arising posteriorly, is the occipital artery. The occipital artery runs steeply upwards, then passes deep to the digastric and splenius muscles. It re-emerges here and runs upwards, branching to supply the posterior part of the scalp.

25.48

Also arising posteriorly up here is the smaller posterior auricular artery. It runs more superficially to supply the scalp behind the ear.

26.01

We'll remove these two posterior branches to see one more branch that arises deeply, the ascending pharyngeal. It passes upwards deep to the external carotid to supply the upper part of the pharynx.

26.17

Now we'll move upward to look at the last two branches of the external carotid artery. The highest part of the external carotid artery lies within the deepest part of the parotid gland, which has been removed in this dissection.

26.32

This branch is the superficial temporal artery. Just as it arises, it gives off this branch, the transverse facial. The superficial temporal artery then runs upwards and laterally, emerging from behind the neck of the mandible. It crosses the zygomatic process of the temporal bone just in front of the external ear, which we'll add to the picture. The superficial temporal artery continues within the superficial temporal fascia, branching to supply the upper and lateral parts of the scalp.

27.10

To see the final branch of the external carotid, the maxillary artery, we'll remove this transverse facial artery. Here's the start of the maxillary artery. It arises as the continuation of the external carotid, behind and medial to the neck of the mandible. It passes forwards. To follow it , we'll remove the masseter, the zygomatic arch, the temporalis muscle, and the ramus of the mandible.

27.44

This brings us into the infratemporal fossa. This is the lateral pterygoid muscle. It's been divided here. The maxillary artery runs forward, passing either below the lateral pterygoid muscle, as it does here, or through it.

28.03

The maxillary artery has many branches. These include branches to the muscles of mastication, and alveolar branches to the upper and lower jaws. This important early branch, the middle meningeal artery, passes upward. It goes through this opening in the bone, the foramen spinosum.

28.28

From the foramen spinosum, which is here, the middle meningeal artery fans out, creating these grooves on the inside of the cranium. The middle meningeal artery runs within the thickness of the dura. It supplies the dura, and much of the skull.

28.48

We'll return to where we were, on the maxillary artery. Here it gives off an infra-orbital branch that passes through the inferior orbital fissure. Then the maxillary artery turns medially, entering the pterygo-maxillary fissure, where it ends by branching to supply the lining of the nasal cavity, and the palate.

29.11

EXTRACRANIAL VEINS

Now we'll move on to take a look at the major veins of the head and neck. Outside the cranial cavity, the smaller veins generally run close to the corresponding arteries. We'll look only at the larger veins, starting with the principal vein of the head and neck region, the internal jugular vein.

29.28

To see the internal jugular vein we'll start with a dissection in which it's been removed. Here's the internal carotid artery, about to enter the carotid canal. The internal jugular vein begins here at the jugular foramen, where, as we've seen, it's continuous with the sigmoid sinus.

29.51

Now we'll add the internal jugular vein to the picture. The upper part of the internal jugular vein lies behind the internal carotid artery. It lies just medial to the styloid process, and medial also to the the styloid muscles, and the posterior belly of the digastric. Just below the level of the angle of the mandible, which we'll add to the picture, the internal jugular vein receives this large vein, the common facial vein.

30.28

The common facial vein is formed by a joining together of veins that drain the face, the infratemporal region, the oral and nasal cavities, and the larynx. The internal jugular vein continues down the neck, behind the common carotid artery and lateral to it. It's crossed by the omohyoid muscle.

30.51

Down here behind the clavicle the internal jugular vein ends by joining with the subclavian vein to form the brachiocephalic vein. As shown in Tape 3, the two brachiocephalic veins pass through the superior thoracic aperture. In the thorax the two brachiocephalic veins join to form the superior vena cava.

31.16

The internal jugular vein is covered over by the sternocleidomastoid muscle. We'll add just the upper and lower ends of the muscle to the picture. Here's the lower end of it, here's the upper end. Above, the vein lies slightly in front of the sternocleidomastoid muscle.

31.39

Below, it lies just lateral to the interval, between the sternal and clavicular insertions of the muscle. We'll add the rest of the sternocleidomastoid muscle to the picture, then we'll add the major superficial veins of the neck.

31.59

This is the external jugular vein. Its formed below the ear by a joining of veins from the scalp and face. The external jugular vein crosses the lateral border of the sternocleidomastoid muscle, and passes behind the clavicle to join the subclavian vein, which is here.

32.19

This is the anterior jugular vein, it's quite small in this individual. It also empties into the subclavian vein.

32.27

To make the veins clearly visible in the dissection we've seen, they were filled with a colored material. Normally when we're upright and at rest, gravity keeps the veins of the head and neck almost empty. They fill up when we lie down, or raise our intrathoracic pressure.

32.45

Now that we've looked at the principal veins, let's review what we've seen of the blood vessels of the head and neck.

32.52

REVIEW

Here's the subclavian artery, the thyro-cervical trunk, the inferior thyroid artery, and the vertebral artery. Here's the common carotid, dividing into the external, and internal carotids.

33.17

Within the cranium here are the vertebral and internal carotid arteries, the ophthalmic artery, the anterior cerebral, anterior communicating, posterior communicating, and middle cerebral arteries.

33.36

Here are the inferior cerebellar arteries, the superior cerebellar arteries, and the posterior cerebral arteries.

33.46

Here's the superior sagittal sinus, the straight sinus, the transverse sinus, the sigmoid sinus, the cavernous sinus, the superior petrosal and inferior petrosal sinuses.

34.05

Here's the external carotid again, here's the superior thyroid artery, the lingual artery, the facial artery, the occipital, and posterior auricular arteries, the ascending pharyngeal, the superficial temporal, and maxillary arteries.

34.30

Here's the internal jugular vein, the common facial vein, the external jugular, and anterior jugular veins.

34.42

That brings us to the end of this section on the blood vessels of the head and neck. In the next section, we'll look at the eye and its surroundings.

34.57

END OF PART 4

PART 5

THE EYE AND ITS SURROUNDINGS

00.00

In this section we'll look at the eye and its surroundings. We've already seen the nerves of the orbital region in part 3 of this tape. In this section we'll first look at the bony features of the orbital cavity, then we'll look at the eye itself, then at th eeye muscles, and lastly the eyelid and lacrimal apparatus.

00.28

ORBITAL CAVITY

Let's start with the bones. This is the bony orbit, or orbital cavity. It's described as having a roof, a floor, a medial wall, and a lateral wall. The rim of the orbit, is called the orbital margin. It's thick and clearly defined above, laterally , and below. Here medially the orbital margin is less distinct: the medial wall of the orbit blends with the countours of the nose and the central part of the forehead.

01.11

The orbital margin curves distincly backwards, both above, and below. Because of this the orbital margin is much further back laterally, than it is medially.

01.27

This reflects an imortant fact about the orbital cavity: it doesn't face directly forwards. We can see this best in a skull in which the roof of the orbit has been removed. This lets us look down into the orbit from above.

01.45

The medial wall of the orbit faces directly forward, but the lateral wall is angled outward by about 45º, so that the center line of the orbit is a little over 20º off the mid-line.

02.00

As we saw in tape 4, several bones are involved in forming the orbit. Starting medially this is part of the ethmoid bone, this is the underside of the frontal bone, this is the zygomatic bone, this is part of the maxilla, so is this, and this is the lacrimal bone.

02.23

Back here are the greater, and lesser wings of the sphenoid bone. Here at the narrow apex of the orbit are the optic canal and the superior orbital fissure.

02.38

The optic canal transmits the optic nerve and ophthalmic artery; the superior orbital fissure transmits the other nerves that enter the orbit and the superior orbital vein. In the living body the inferior orbital fissure, which forms an apparent gap between the floor and the lateral walls is bridged over with fibrous tissue.

03.04

This groove, the lacrimal groove leads downwards into the opening for the naso-lacrimal duct, which takes tears to the nasal cavity. The rim of the lacrimal groove is formed by the posterior lacrimal crest behind, and the anterior lacrimal crest in front.

03.25

The medial palpebral ligament is attached here, the lateral one here. The palpebral ligaments hold many of the anterior structures of the orbit in place.

03.38

EYE AND EXTRA-OCULAR MUSCLES

Now we'll move on, to look at the main externally visible parts of the eye itself. In life we see only a small part of the eye: even at the limit of eye movement we see less than half of its circumference.

03.33

Here's the eye seen from above. It occupies only the anterior part of the orbit. The space behind it is largely occupied by fat, that's been removed in this dissection.

04.05

The tough outer coat of the eye is the sclera. The sclera extends from here behind, where the optic nerve passes though it, all the way round to here in front, where it becomes continuous with the transparent cornea

04.21

The cornea is the transparent window that allows light to enter the eye. The cornea is more sharply curved than the sclera: it bulges forwards. Behind the cornea, the colored iris forms an incomplete partition within the eye.

04.40

At the center of the iris is a clear opening, the pupil. The size of the pupil is constantly changing, to limit the amount of light that enters the eye. The iris is formed chiefly of muscle fibers. Fibers arranged radially cause the pupil to dilate, fibers arranged circumferentially both here, and out here, make it constrict.

05.05

The lens of the eye is just behind the iris and the pupil. Here light from a slit lamp is coming in from the left side. Down here where it's very bright the light is hitting the iris. Here it's hitting the anterior surface of the lens.

05.23

The internal structures of the eye are so delicate and so readily displaced that they can't be well shown by dissection. They're better understood by referring to microscopic images and diagrams, to which I hope you'll have acess.

05.38

Now we'll move on to look at the extra-ocular muscles. There are seven of them. One, as we'll see, raises the upper eyelid. The other six, the four rectus muscles and the two oblique muscles, move the eye. The best way to look at these muscles is from above.

05.57

Here we're looking down into the obit, in a dissection in which the orbital roof has been removed

06.04

We'll start by looking at the rectus muscles. To see them, we'll take these two muscles, the levator and the superior oblique, out of the picture. We'll also remove some of the fat that largely fills the posterior part of the orbit.

06.20

Here are three of the rectus muscles: superior, lateral and medial. To see the inferior rectus we'll remove the superior rectus, the optic nerve, and the rest of the orbital fat. Here's the inferior rectus muscle. Between the origins of the rectus muscles the optic nerve emerge.

06.50

The rectus muscles arise together from inside a ring of fibrous tissue, the anulus tendineus, of which this is the upper part. The anulus is attached to the periosteum of the apex of the orbit. Its ring of attachment, represented in blue here, encircles the optic canal, and this part of the superior orbital fissure. The optic nerve, the ophthalmic artery, and several of the nerves to the orbit pass through the anulus.

07.23

The rectus muscles thin out into flat tendons as they pass forwards around the eye. They insert into the sclera quite far forward. To see where they insert, we'll go round to a view from in front. Here's the insertion of the superior rectus, here's the lateral, here's the inferior, here's the medial.

07.51

The main actions of the rectus muscles are obvious. The superior and inferior rectus muscles turn the eye upwards, and downwards, the lateral and medial ones turn it outwards and inwards.

08.09

The inferior and superior rectus muscles have another action too. They don't only pull the top or bottom of the eye straight backwards, they also tend to rotate it a little, about its long axis.

08.24

The superior rectus muscle acting alone would rotate the top of the eye inward as we look up, the inferior rectus would rotate it outward as we look down.

08.34

In fact the rectus muscles don't act alone. They act in conjunction with the two oblique muscles, the inferior oblique, and the superior oblique. We'll add those to our picture, starting with the superior one.

08.49

Here's the superior oblique muscle. Like the rectus muscles it arises from the anulus. The superior oblique narrows into a tendon, which passes around this sling of fibrous tissue, the trochlea.

09.06

The trochlea is attached to bone here, behind the orbital margin. The trochlea acts as a pulley. The superior oblique tendon fans out, passing deep to the superior rectus to insert into the sclera on the top of the eyeball.

09.26

We'll go round to our view from in front, and add the oblique muscles to that picture. Here's the trochlea, here's the superior oblique tendon. The superior oblique muscle, acting alone, would rotate the top of the eye medially.

09.47

The inferior oblique muscle is down here. It's the only extra-ocular muscle that doesn't arise from the anulus. It arises here, behind the inferior orbital margin. It inserts into the sclera quite far back. To see that we'll go round to our view from above and behind.

10.11

Here's the inferior oblique, inserting into the sclera between the lateral rectus and the inferior rectus muscles. The inferior oblique, acting alone, would rotate the top of the eye laterally.

10.31

The oblique muscles act in conjunction with the rectus muscles, the inferior oblique with the superior rectus and vice versa. This prevents our eyes from rotating about their long axes, as we look up and down.

10.45

The last of the seven extra-ocular muscles to look at is the levator of the upper eyelid, levator palpebrae superioris.

10.53

The levator lies just above the superior rectus muscle: here it is. Arising from the anulus fibrosus back here, the levator fans out to become a broad tendon which inserts, as we'll see later, mainly into the tarsus of the upper lid.

11.15

Incorporated in the underside of the levator is a strip of smooth muscle, the superior tarsal muscle, that's innervated by sympathetic fibers. Changes in the tone of this smooth muscle cause our upper lids to droop when we're tired, and open wide when we're excited.

11.36

As we saw in the section on the cranial nerves, the extra-ocular muscles get their nerve supply from the third, fourth and sixth cranial nerves. The superior oblique is supplied by the fourth nerve, the trochlear; the lateral rectus is supplied by the sixth nerve, the abducent. The other five are supplied by the third nerve, the oculomotor.

12.00

In the images that images that we've seen so far, the muscles have been dissected bare to show them clearly, but in reality each of the muscles as it passes forwards becomes surrounded by a sliding sheath of fibrous tissue. The fibrous sheaths of adjoining muscles blend together to form a hood above and below the eye. This hood is firmly attached to periosteum at two points: here laterally and here medially

12.35

These fibers of attachment form the posterior parts of the lateral and medial palpebral ligaments. Indirectly, they hold the eye in position in the orbit. The tendon sheaths of the muscles are also continuous with this sheath of fibrous tissue, the capsule of the globe, that surrounds the posterior two thirds of the eyeball.

12.58

EYELIDS AND LACRIMAL APPARATUS

Now that we've looked at the extra-ocular muscles, we'll move on to look at the eyelids and the lacrimal apparatus. The eyelids form a movable protective covering for the eye.

13.11

The upper and lower lids are much alike: we'll look mainly at the upper one. In looking at the structures that form the eyelids, we'll switch between a dissection from in front, to one in which the structures have been divided in steps, a layer at a time, giving us this lateral view.

13.33

The eyelids are covered on the outside with skin that's extremely thin and mobile. They're covered on the inside inside by a thin sensitive membrane, the conjunctiva. This is the conjunctiva. Conjunctiva also covers the front of the sclera,

13.54

The conjuctiva that covers the eye - the bulbar part - and the conjunctiva that lines the lid - the palpebral part - are continuous at this fold, the conjunctival fornix. The conjunctiva is continuous with the skin at the margin of the eyelid.

14.11

Directly beneath the skin of the eyelids, which we'll remove, is the orbicularis oculi muscle. As we saw in part 1 of this tape, the orbicularis extends beyond the margins of the orbit, onto the forehead and the cheek.

14.29

It's such a thin muscle, it's almost colorless. Medially, many of its fibers arise from this structure, the medial palpebral ligament, which is attached to bone here at the anterior lacrimal crest. The more outlying fibers of orbicularis arise from bone here around the lacrimal groove

14.52

Laterally, the innermost fibers of orbicularis insert into bone here. The more outlying fibers have no bony attachment. This is part of the orbicularis. It's been divided along this line.

15.09

Directly beneath it is this layer of fibrous tissue, the orbital septum, that extends into the lid from the periosteum at the orbital margin. The orbital septum separates the contents of the orbit from the facial soft tissues. Here beneath the orbicularis is the structure that gives the eyelid its shape, the tarsus. It extends from here, to the lid margin.

15.36

To see the tarsus from in front we'll remove the orbicularis muscle, and then the orbital septum. We've also removed much of the orbital fat. The tarsus is here.

15.54

If we put something underneath it we can see its upper border. The tarsus is tethered at each end to the palpebral ligaments. The tarsus is quite flexible. It stiffens the eyelid, and gives it a curvature that varies so that the shape of the eyelid conforms to the changing curvature of the underlying eye.

16.17

Within the thickness of the tarsus are numerous tarsal glands. This is one of them. The tarsal glands open here, right along the margin of the lid. The tarsal glands produce an oily secretion which prevents the spillage of tears.

16.38

This structure coming down from behind is the levator muscle. This is its tendon. The levator tendon inserts mainly into the tarsus; its most lateral and medial fibers are attached to the palpebral ligaments.

16.58

Here's the orbital margin. Here just below and behind it is the lacrimal gland, which secretes tears. It lies in this hollow in the roof of the orbit, the lacrimal fossa. The many small ducts of the lacrimal gland open into the conjuctival fornix up here.

17.18

Tears leave the space in front of the eye through two small openings called puncta: here's the lower punctum. To see the upper one we'll roll the upper lid outwards. Here's the upper punctum.

17.35

To see where those lead we'll look at a dissection in which the orbicularis has been removed, and blue material has been injected into the puncta. Here's the upper punctum, here's the lower one.

17.50

Leading from them are the canaliculi: here's the upper canaliculus, here's the lower one. The two canaliculi converge behind the medial palpebral ligament, which we'll remove. The canaliculi join together, and enter this reservoir, the lacrimal sac.

18.12

The lacrimal sac is surrounded by the fibers of origin of the orbicularis muscle. When we blink, the pressure from these muscle fibers squeezes tears from the lacrimal sac, down into the nasolacrimal duct.

18.28

Now that we've looked at the eyelids and lacrimal apparatus, let's review what we've seen of the eye and its surroundings.

18.37

REVIEW

Here’s the orbital margin, the optic canal, the superior orbital fissure, the inferior orbital fissure, the lacrimal groove, the posterior lacrimal crest and the anterior lacrimal crest.

19.00

Here’s the sclera, the cornea, the iris, and the pupil. Here are the rectus muscles: superior, lateral, medial, and inferior; and the oblique mucles: superior, and inferior. Here’s the trochlea, here’s the anulus tendineus,

19.29

Here’s the conjunctiva, palpebral, and bulbar. Here's the orbicularis oculi muscle, the orbital septum, the tarsus, and the tarsal glands.

19.45

PART 6

THE EAR

00.00

In this section on the ear we'll look mainly at the external and middle ear. The inner ear is so delicate, and so encased in hard bone, that it can't be well shown by dissection. We'll start with the external ear.

00.23

EXTERNAL EAR, TYMPANIC MEMBRANE

The external ear consists of the auricle, which projects from the side of the head, and the external auditory meatus or ear canal, which passes inwards to the tympanic membrane. We'll look at the auricle first.

00.37

The folded outer rim of the auricle is the helix. The helix spirals down into the floor of the central concavity, the concha. The rim of the concha is defined by this curved ridge, the antihelix.

00.52

Two projections, the tragus, and the antitragus, partly hide the entrance to the external auditory meatus. The shape of the upper three quarters of the auricle is determined by the cartilage that forms its framework. We'll divide the auricle along this line to see the cartilage.

01.11

Here's the cut edge of the auricular cartilage. It's highly elastic. The skin of the the auricle is attached to the cartilage closely on the front, less closely on the back. The lowest part of the auricle, the lobule, contains no cartilage. To look at the external auditory meatus we'll remove the auricle, and the surrounding skin.

01.37

The external auditory meatus is lined with skin. It isn't straight: it curves slightly upwards, then slightly backwards. The external meatus ends medially at the ear drum, or tympanic membrane. This is part of the tympanic membrane: we'll see all of it in a minute.

02.06

The outer part of the external meatus is supported by a partial tube of cartilage. Here's the cut edge of the cartilage: it's continuous with the cartilage of the auricle. To see it better we'll remove the surrounding soft tissue.

02.25

Here's the cartilage of the external auditory meatus: it extends much further below, than it does above. To see where we are we'll take a look at the same area in a dry skull. Here's the bony opening of the external auditory meatus. The cartilage of the external auditory meatus is attached to bone here.

02.48

Here's the beginning of the zygomatic arch, here just below it is the temporomandibular joint. The condyle and neck of the mandible lie just in front of the external auditory meatus.

03.;01

Going back to the dissection, here's the capsule of the temporomandibular joint. With a finger in the external meatus, it's easy to feel the condyle moving.

03.17

Now we'll remove the mandible, so that we can look at the external meatus from in front. Here's where the cartilage of the external meatus attaches to bone. We'll remove the cartilage, to see the bony part of the external auditory meatus. This brings us closer to the tympanic membrane: here it is. To get a complete view of it we'll remove this part of the bone.

03.47

This is the tympanic membrane. It separates the external meatus from the middle ear, or tympanic cavity. The tympanic membrane is so thin that it's partly transparent. This small upper part of the tympanic membrane, the pars flaccida, is slack. This much larger part below, the pars tensa, is tense.

04.14

The tense part of the tympanic membrane has the shape of a shallow cone: it's drawn inwards by its attachment to the handle of the malleus, which we can just see here. The apex of the cone, where the tip of the malleus is attached, is called the umbo.

04.33

The tympanic membrane faces downwards and forwards. This is a true lateral view of it. When seen from the side, it's tilted in this plane. When sound waves strike it, the tense part of the tympanic membrane vibrates. Its vibration is transmitted to the malleus.

04.56

The tympanic membrane is formed of a layer of skin on the outside and a layer of mucous membrane on the inside, lying back-to-back on a layer of supporting fibers.

05.06

The support fibers within the tympanic membrane are attached around the circumference, except between these two points, to a ring of fibrocartilage, the anulus. The anulus fits into a groove in the bone.

05.22

To see beyond the tympanic membrane we'll remove this part of the bone, leaving the anulus intact.

05.32

This brings us into the lower part of the tympanic cavity, or middle ear. We'll see a little more of it by dividing the tympanic membrane along this line, and removing it. Here's the handle, or manubrium, of the malleus, attached to the tympanic membrane. Here below it we can see how thin the membrane is.

5.55

TYMPANIC CAVITY, AUDITORY TUBE

Now we'll remove the rest of the tympanic membrane. Here we're looking into the lower part of the tympanic cavity. There's more of it back here, and up here, as we'll see.

06.10

This is the handle of the malleus, this is our first look at the incus, and the stapes. We'll get a much better look at them later. Here in front is the opening for the auditory tube, which connects the tympanic cavity with the nasopharynx.

06.26

We'll look at the auditory tube, then come back to the tympanic cavity, but first let's look at a dry bone specimen to see where we've been and where we're going next. After taking the mandible out of of the picture, we've been looking up at the underside of the petrous temporal bone from below. To see the tympanic membrane we removed this part of the bone.

06.53

Here's the bony external meatus, here's the groove for the anulus. To see into the tympanic cavity we removed more bone here. This is the lower part of the tympanic cavity with the three small bones removed.

07.11

This is as far as we've come till now. The auditory tube, which is where we're going next, begins at this opening at the front of the tympanic cavity. It passes forwards and medially in a narrow tunnel in the bone. The tunnel is quite short: it starts here, and ends here.

07.36

Only the lateral third of the auditory tube goes through bone; its medial two thirds pass though a partial tube of cartilage that’s represented by this added material. The cartilage of the auditory tube is attached to the base of the skull. Its medial end projects beneath the mucosa of the nasopharynx.

07.59

To see the auditory tube itself, we’ll go back to a dissected specimen. In this deep dissection of the infratemporal region we've removed the zygomatic arch, the mandible, and all the muscles of mastication.

08.19

The external auditory meatus, and the tympanic cavity have been exposed, as in the previous dissection. Here's the lateral pterygoid plate. The nasopharynx is here. This is the superior pharyngeal constrictor. Its upper border is here.

08.40

The auditory tube is up here. It’s concealed between these two small muscles. This one is the levator palati, passing down above the free border of the superior constrictor. This one is the tensor palati, passing downward and forward to go round the hamulus.

09.00

To see the auditory tube, we'll remove the tensor palati, and the lateral pterygoid plate. Here's the cartilage of the auditory tube. Here beneath it is the tube itself. To see the auditory tube all the way to the tympanic cavity we'll open it along this line, and remove this part of the bone.

This is the bony part of the auditory tube, connnecting with the tympanic cavity. This is its cartilaginous part. The narrowest part of the tube is here, where it emerges from the bone.

09.46

The auditory tube enters the nasopharynx here. We saw its emergence into the nasopharynx from the inside in Tape 4. Here's the nasopharynx, here's the back of the nasal cavity, here's the soft palate, here's the opening of the auditory tube.

10.09

The auditory tube, also called the eustachian tube, is normally closed. It's opened momentarily when we swallow or yawn, by the action of the tensor and levator palati muscles. Occasional opening of the auditory tube keeps the air pressure the same on both sides of the tympanic membrane.

10.30

Now that we've seen the auditory tube we'll come back to the tympanic cavity. In it we'll see the three small bones, the auditory ossicles, that conduct sound vibrations from the tympanic membrane to the inner ear.

10.45

So far we've just had a preview of this lower part of the tympanic cavity. To see the whole of the tympanic cavity we'll remove the bone that lies above and behind the external auditory meatus. Now if we look up from below we can see the full extent of the tympanic cavity.

11.07

With the auditory ossicles in place the picture is rather busy. We'll remove them for now, along with the bone here, and here, to give ourselves a clear look at the medial wall of the tympanic cavity.

11.22

These two openings in the medial wall both lead to the vestibule of the inner ear. The oval one above, the vestibular window, is occupied by the stapes. This round one below it, the cochlear window, is closed off by an inactive membrane.

11.42

This bulge, the promontory, is formed by the basal turn of the cochlea. The facial nerve runs here in the facial canal, just beneath the bony surface. In front, as we've seen, the tympanic cavity is continuous with the auditory tube.

11.59

Up here behind, it's continuous with a collection of air-filled spaces, the mastoid air cells, which we'll look at in a dry specimen. Here's the tympanic cavity. In this skull we've made an opening in the upper part of the mastoid process to expose the mastoid air cells. Here are the air cells. The tympanic cavity is through here. The mastoid air cells don't go anywhere: collectively they're a dead end.

12.35

AUDITORY OSSICLES

Now we'll put the three auditory ossicles back into the picture. They're the stapes, the incus and the malleus. We'll start with the tiny stapes, the smallest bone in the body.

12.48

The stapes consists of a head which articulates with the incus, an arch that's formed by the posterior crus, and anterior crus, and an oval base or footplate, which occupies the vestibular window.

13.06

Here's the vestibular window. We'll add the stapes to the picture. The edge of the footplate is attached to the inside of the window by a membrane that allows it to move. Movement of the stapes sets up sound vibrations in the perilymph of the inner ear.

13.28

The tendon of the tiny stapedius muscle is attached to the head of the stapes from behind. Here's the tendon of stapedius. Its muscle belly is enclosed in bone back here. The stapedius muscle tilts the stapes backwards.

13.48

The head of the stapes articulates with the incus, which we'll add to the picture. Here's the incus. The incus moves the stapes, and is in turn moved by the malleus.

14.05

The incus has a body, a short crus, and a long crus. The long crus curves medially, ending at the lenticular process, wich articulates with the stapes. The short crus points backwards. The tip of the short crus is tethered to the wall of the tympanic cavity here, by the posterior ligament of the incus.

14.34

On the front of the body of the incus there's a saddle-shaped joint surface, at which the incus articulates with the malleus. Here's the joint surface.

14.49

We'll add the malleus to the picture, together with the ligaments that hold it in place, and the bone those ligaments are attached to.

15.00

We've already seen that this part of the malleus that hangs downwards, the handle or manubrium, is attached to the tympanic membrane.

15.08

In the dry bone, this is the manubrium. This is the head of the malleus. This joint surface, facing backwards, articulates with the incus. The malleus is suspended by two ligaments which are attached here behind, and here in front. This is the anterior ligament, this is the posterior one. The two ligaments are in line with each other.

15.39

The malleus makes a rotating movement through just a few degrees, around an axis of rotation that's in line with the anterior and posterior ligaments. There's very little movement at the joint between the malleus and the incus. The two bones move together.

15.58

The movement of the lenticular process causes a tilting movement of the stapes. Movement of the stapes is restrained by the action of the stapedius muscle.

16.15

Movement of the malleus is restrained in a similar way by a second small muscle, the tensor tympani. Here's the tendon of the tensor tympani. The tensor tympani muscle is enclosed in a bony tunnel here above and parallel to the auditory tube. Its tendon turns a corner as it emerges from the bony tunnel. The tensor tympani pulls the manubrium, and the tympanic membrane medially.

16.47

The stapedius and tensor tympani muscles act in response to loud noise. Their action helps to protect the inner ear from noise damage. Lastly we'll add to our picture of the tympanic cavity one highly unusual nerve, the chorda tympani.

17.06

The chorda tympani, a branch of the facial nerve, emerges from bone back here, passes between the malleus and the incus, and leaves the tympanic cavity up here on its way to join the lingual nerve. As we saw in a previous section, the chorda tympani conveys the sense of taste to much of the tongue.

17.27

Now, let's review what we've seen of the structuresof the external and middle ear.

17.33

REVIEW

Here's the auricle, the external auditory meatus, the helix, the antihelix, the tragus, the antitragus, and the concha. Here's the cartilage of the auricle, and the cartilage of the auditory meatus.

18.01

Here's the tympanic membrane, the pars flaccida, the pars tensa, the umbo, and the anulus.

18.13

Here's the tympanic cavity, the vestibular window, the cochlear window, and the opening for the auditory tube.

18.25

Here's the malleus, the incus, and the stapes. Here's the tendon of stapedius, and of tensor tympani, and here's the auditory tube.

18.41

I hope that in future editions of this atlas we'll find ways to show the inner ear as well. For now, we're at the end of this section of the ear. We're also at the end of this tape, the second of two that describe the head and neck. In the next and final tape in this series, we'll look at the internal organs.

19.07

END OF VOLUME 5

Here’s the lacrimal gland, the upper and lower puncta, the canaliculi, the lacrimal sac, and the nasolacrimal duct.

20.01

That brings us to the end of this section on the eye and its surroundings. In the next section, we'll look at the ear.

END OF PART 5