>> Steve Langjahr: So today is May seventeenth. This is lecture 27 in Anatomy. Actually it goes backwards in your textbook, back to chapter 19, the endocrine system. And as you look at the many endocrine glands, you might seem to ask, "Well, how is this is system? We don't see any connectivity. It seems like they're just scattered, sort of random glands." But endocrine glands are connected, and unified, and to some degree, communicate through the circulatory system. So the link or the unification, which is not necessarily shown here, is the circulatory system. But let's back up. What, after all, is an endocrine gland? Pretty early in this course we distinguished two types of glands, those that had ducts and secreted to the outside, those were called exocrine, and those that don't have ducts and secrete instead into the circulatory system, those are called endo, within, endocrine glands. As you know, they produce chemical compounds then which circulate through the blood and those compounds are called hormones. The word hormone is Latin. It's a good name because in Latin it means to set in motion because hormones more or less trigger various events. But they do not have very often widespread effects but most often very selective effects, very precise, very limited action. Indeed they tend to affect only a handful of tissues. And so those tissues that respond to a hormone are said to be its targets. So as we go through this system naturally we're going to give you names for endocrine glands. We'll want you to know their physical location. We'll want you to know their appearance, that means their gross anatomy. Then a bit about their histology, their microanatomy. The hormones that are produced there. The target organs of those hormones. The actions or functions of those hormones. And also the dysfunctions which means just this: An endocrine gland can be secreting its hormone appropriately or it can be secreting too little or – ?

>> Too much.

>> Steve Langjahr: Too much. So we're going to describe hypersecretion or hyposecretion which produce very different symptoms as you'd expect. So those are the objectives. That's essentially what matters for us as we move through this system. Is there any organization to this system? That is, is there any hierarchy within this system? And although it might be a bit of a artificial hierarchy, there is a gland which is kind of in control of much of the endocrine system and it sits inside the cranium you know, in that saddle of the sphenoid called the sella turcica. The name of the gland, generically, is the pituitary which is a complete misnomer because if you look at the derivation of the word, pituitary means mucous. And this has nothing to do with mucous but the early investigators saw it and they thought it looked like a ball of mucous so they dismissed it as mucous. They called it the pituitary gland. So today that term is being discarded and favor of the hypophysis. Deep within the cranial cavity, certainly isolated and you could say protected from trauma. But not entirely so. I love this article. It was in the "Valley Press" years ago. It's a story of a guy who got out of his car, it was a, what was it a 1984 Fiero, and he turned around and the antenna, the radio antenna went up his nose and all the way through his sphenoid sinus into his sella turcica and wiped out his pituitary gland. A freak accident. His neurosurgeon said he's luckily not to wipe out anything. I don't

know if he did or not. But anyway, I offer this as a public service in case you have a 1984 Fiero, you probably want to be careful getting out in case it goes up your nose. Now, yes, it is located in the sella turcica. And the thing is very small. The pituitary gland weighs in at less than six grams which the weight of a nickel. And it's about the size of a pea, P-E-A. So it's a very tiny gland. And despite that, it's actually two glands, that is two separate structures occupying the sella turcica. The forward part is called the adenohypophysis. We can also call it the anterior lobe. The prefix, adeno- refers to a gland, something that is truly epithelium. And the adenohypophysis is glandular epithelium. In other words, it's not made of nerve cells despite its proximity to the brain. Now the back part, here seen in yellow, is called the posterior pituitary and it's also better known as the neurohypophysis which clearly represents, emphasizes the fact that it is made of nerve tissue. So the posterior lobe is actually connected to and part of the brain. Whereas the anterior lobe has nothing to do with the brain and is coincidentally alongside the posterior lobe. Now based on this drawing, which part of the pituitary is larger it seems? The anterior lobe is larger, posterior lobe, quite a bit smaller. And with that said, you would expect that perhaps the anterior lobe has more functions and we'll see that to be true. Posterior lobe, relatively few hormones produced here. So let's start with the easy one, the yellow piece there, which is called the posterior lobe, also known as the neurohypophysis. Notice that it is literally connected to and actually a part of the brain, specifically the hypothalamus. So it's really fair to say that the neurohypophysis is just an extension, an extension of the hypothalamus. And, in fact, the hormones that are produced by the neurohypophysis are actually not produced there at all. They are produced in the hypothalamus and they move down and are stored in the neurohypophysis. So what I've just said is the neurohypophysis doesn't produce any hormones, it simply stores two of them that are manufactured by the brain, specifically the hypothalamus. The two hormones are interesting and quite different, totally different really. The first of the two is called oxytocin which is a word in Latin which means swift childbirth, swift childbirth, or rapid childbirth. And with that said, you can guess perhaps one of its functions. And so let's just get it out on the table here. Oxytocin targets smooth muscle. And what's the largest concentrated mass of smooth muscle, at least in a female?

[Inaudible]

The uterus. So especially causes contraction of the uterus. And also the ducts in the breast which bring milk out to the nipple, a process called milk letdown, or delivery of milk at the outside. Oxytocin. Can this be available in hospitals and put to use in obstetrical practice?

>> Pitocin?

>> Steve Langjahr: Yes. It is called Pitocin. That's the trade name. And it's an easy connection because P-I-T is a reference to – ?

>> Pituitary.

>> Steve Langjahr: Pituitary. So Pitocin is used for what purpose then? Hmm. To stimulate contraction of a uterus. And when would you want to do that? To induce labor, to stimulate labor, to bring on labor. And in fact, any of you that are mothers probably had Pitocin, not necessarily before delivery, but certainly after delivery which oddly seems inappropriate. Why would you want to give this hormone after the baby's been delivered? Well, what happens after delivery? What gets delivered after the baby is the – ?

[Inaudible]

Placenta. And do you want the uterus to contract and expel the placenta and minimize at the same time blood loss? So Pitocin is very useful to cause expulsion of the placenta and cause contraction of the uterus, therefore minimizing blood loss in the case of labor and delivery. Interestingly, this hormone has other effects, not just on the uterus, but on the brain. They've shown that this hormone is responsible for maternal behavior. And, in fact, this is the reason, one of the reasons, that newborn, that is mothers, new mothers are encouraged to nurse their young, not just for nutrition, but what's sometimes the word that's used in encouraging a mother to breastfeed? Mm.

>> Bonding.

>> Steve Langjahr: Bonding. Maternal-child bonding. Because it induces maternal behavior. In animal studies where they removed the source of oxytocin, namely what? Namely the posterior pituitary. Animals will give birth, female animals will give birth and then what? Walk away. Walk away. Leave them there to die. So maternal behavior, one of the side effects or secondary actions of this. Interestingly, I know I'm going on, it also tends to improve empathy, and compassion, and generousness. Aren't these properties of females, not so much of males?

[Laughter]

So then what's it doing in males? Do males have this hormone? They do but not so much. Next. Antidiuretic hormone which speaks for itself. The word diuresis means to make urine. So clearly this hormone helps to minimize urine formation. It's also known as vasopressin, that's its nickname. And that word describes its other action which is to cause contraction of blood vessels, therefore helping to support BP. What's BP?

[Inaudible]

Blood pressure. But its most famous action is on the kidney. And so we would say the kidney is the T-word. What's the T-word here? The – ?

>> Target.

>> Steve Langjahr: Target. Again, you're going to be asked this information. What is the target of ADH?

>> Kidney.

>> Steve Langjahr: The kidney. And what's it do there? It improves water reabsorption. And therefore minimizes water loss. What would be your expectation if the pituitary didn't secrete enough of this? What would be the symptom of too little antidiuretic hormone?

[Inaudible]

Mm. You might have low blood pressure but the worst symptom would be you wouldn't absorb all the water you should along the nephron. So huge quantities of water being lost, water loss. Also, interestingly, this hormone can be available by prescription and some parents actually ask for this hormone, not for themselves, but for their kids, their young kids, six, five, seven, in those age brackets. Why would this be given to a child at night? I mean that sounds rather barbaric. But what reason might be thought of here?

>> Bedwetting.

>> Steve Langjahr: Bedwetting. And is bedwetting a traumatic or at least a big deal at that age? Yeah. So I'm not advocating this. I'm not saying you should run out and buy it. In fact, you can't run out and buy it. You'd have to get a prescription. But it can be used in that way. So these are the two hormones. Remember both actually produced in the hypothalamus, simply stored and secreted here from the neurohypophysis. Let's flip over. Let's look forward to the adenohypophysis, also known as the anterior pituitary, or anterior lobe of the hypophysis. A lot going on here. And this is a short list. So we'll limit it to seven. Yep. Seven very different hormones produced here. Each one controlled by a different mechanism. Each one having a different target. Each one having a very different action. So there's a lot going on in this tiny area of the adenohypophysis. So in no particular order, let's run down them. The first one, self explanatory, it's called – ?

[Inaudible]

Growth hormone. You would expect and you'd be right that this is associated with growth. You'd expect but you'd be wrong that this is important only in childhood. Is it important in childhood? Yes. It is important, however, throughout life. So it's not something limited to children. It's something that is important throughout adulthood. Its abbreviation, hGH, that stands for human growth hormone. It, too, like many hormones, can be available by prescription. And its action is to stimulate the skeleton and therefore bring about rapid growth of the bones and therefore lead to obviously an increase in height. It also stimulates muscle development, skeletal muscle. And with that said, would this hormone be in high demand in the bodybuilding underground? Bodybuilding underground. People selling drugs for bodybuilders. Might they be seeking out hGH? Yeah. I remember an article of Sylvester Stallone was detained at an airport because he had a whole briefcase of this. Anyway, hGH, human growth hormone. It also has a rather undesirable side effect of raising what? Raising blood sugar. So it's not without risk. It is true that growth hormone is highest in juvenile years and it does tend to taper off as we age. You might say, “Well, you know, I’m kind of vertically challenged. I think I’ll go get some of this and get taller.” Can you, as adults, take this hormone and get any taller?

>> No.

>> Steve Langjahr: No. Because your diaphysis and your epiphysis have fused and there’s no way you’re going to get larger with this hormone. Could you have used this in your teenage years and might it have made you taller? Yes. And maybe you think, “Well, I missed that boat.” But it’s pretty expensive. A year’s supply of this is at least $20,000 and you’re not going to get away with one year, are you? You’re going to have to multiply that by ten. So it’s not something that you could buy, or at least afford rather easily. Here’s a person. It happens to be Robert Wadlow. He still has the world record for what? He’s not this guy. And he’s not this guy. Actually this is his dad and this is his brother. But you can see he measured how high? Eight foot eleven inches, at what age? At 22. He died in his twenties. And this is typical of giants. And this is called pituitary gigantism, of course. Now these two handsome people here seem to have a bit of a vertical challenge of their own, right? And what hormone might they be apparently lacking? This one right here, pituitary growth hormone. And so for that reason they’re called dwarfs but the specific kind of dwarfism here, to emphasize the lack of hGH is pituitary dwarfism. Now I want to make the distinction because this person, famous as she is, is not a pituitary dwarf. Why isn’t she a pituitary dwarf? Look at her head. Look at her body. Normal in size but she has very short what? Very short arms, very short legs. This is, well, it’s right here, achondroplasia which has nothing to do with the pituitary but sometimes these folks get confused with your pituitary dwarf. Which of these two folks do you suppose has a tad excess of hGH? This person right here. And they tend to be employed in what industry? Folks like that tend to get hired on, even if they’re not particularly skilled, they tend to be hired on as basketball players. This is an ad out of “Life” magazine years and years ago. And sadly probably you don’t know either of these folks. One is Wilt Chamberlain. The other is Willie Shoemaker. Guess what Wilt Chamberlain did during his career?

[Inaudible]

Basketball, you guessed that. What did Willie Shoemaker do?

[Inaudible]

No, not shoes. Good guess. But no, actually a jockey. Aren’t jockeys, well, necessarily small folks? All right. So interesting story. What if you had too much growth hormone at your age? You’re not going to shoot up because, remember, your diaphysis and your epiphysis are fixed. But here’s the case of an identical twin. These are twins, twin boys. Whoops. There’s goes that. Which did I knock out? Right here. All right. And I also tweak that, too, didn’t I? All right. There we go. They’re twins, but yet obviously they’re different. And what do you think? This guy here, same age, born the same day, actually these are brothers. Notice his arms, notice his hands, notice his feet. This is his brother's foot. This is his foot. So this is something called, well, hypersecretion, hypersecretion of hGH. And when this happens as an adult, it produces a very interesting change, not in height, but in facial features and also in the hands. This is the same person, same person. High school photo. Here she is later. She didn't get taller but notice her face changed quite a bit. Notice her hands got very coarse and masculine. And if she stuck out her tongue, you'd see a rather large tongue. So this is something called acromegaly. You can read about it in your book. It's essentially too much what?

[Inaudible]

Too much growth hormone. And how do you treat that? Well, that's a little tricky because this hormone is produced by the adenohypophysis. And you might say, "Well, remove the adenohypophysis. Your problem is solved." Actually not. Now you have not hypersecretion, but hyposecretion. And worse than that, you've got six other hormones that you've taken out at the same time. So dealing with that, a little bit tricky. But let's move on. There are in fact seven hormones here so number adrenocorticotropic hormone. Quite a mouthful. And interestingly this is the acronym, of course, ACTH, but do understand we're not going to accept ACTH. You got to spell out what – ?

[Inaudible]

The whole thing. And you might say, "OMG, why?" Well, because the word is very helpful. I mean let's dissect it. What is this? Adreno- cortico- tropic hormone. Tropic, we're going to see that word a lot. Tropic means to stimulate. And apparently this is a hormone which stimulates the adrenal cortex and that tells you it's target then. So it influences the production and secretion of many, many of the adrenal cortical hormones that we'll get to before we're done today. This next hormone is equally intuitive. In other words, obvious in its name. It's called S, excuse me, TSH, which stands for – ?

[Inaudible]

So let's guess what the target is. Let's guess what it does. Actually there's no guessing at all. It obviously stimulates the – ?

>> Thyroid.

>> Steve Langjahr: Thyroid. Next, item d, prolactin which needs some clarification. Pro, does it mean professional? Not for us. Pro means to promote, to promote something. What are we promoting here? Promoting lactin, whatever that is. Lactin is a reference to making and secreting milk. So prolactin, which is abbreviated PRL, is obviously involved in initiating and maintaining milk production. In which sex obviously?

>> Women.

>> Steve Langjahr: And all the time or just some of the time? Are all of you women lactating? Sorry. No offense there. But I'm sure that's not the case. So

when is this hormone important?

[Inaudible]

Not during pregnancy but immediately upon delivery. And without this hormone what wouldn't get done would be lactation. Do males have prolactin?

[Inaudible]

Yes. Why don't they lactate? Could they lactate? Yeah, they could. So this is a fun little experiment you could do around the house if you've got a male laying around that's, you know, not pulling his weight.

[Laughter]

You could slip him some estrogen, slip him some progesterone, and then work in some prolactin and low and behold he'd be lactating all over the place. And then you could, you know, share the kid back and forth, "Here, you're turn."

[Laughter]

I'm only joking.

[Laughter]

But is it possible for men to lactate? Do they have the equipment? Yeah. They just don't have the hormones. What hormones?

[Inaudible]

Well, they don't have prolactin in sufficient quantities. And we hope they don't have estrogen or progesterone because if they did, well, let's just say they wouldn't be very manly. All right. So anyway. Prolactin. Then there's this obscure hormone, MSH, an acronym for melanocyte-stimulating hormone. Again, self explanatory. What are melanocytes? Where are melanocytes? And what do melanocytes do?

[Inaudible]

Melanocytes are in your – ?

>> Skin.

>> Steve Langjahr: Skin. And they produce a – ?

>> Melanin.

>> Steve Langjahr: Pigment called melanin. Not myelin, melanin. What color is melanin? Brown. So what do you suppose this hormone does? What's it target? Of course, the skin. And it causes darkening of the skin. Now when this hormone was first isolated and indeed it's very important in animals and less so in humans, but there was quite a bit of excitement around because those that discovered it thought, "Well, goldmine here, goldmine." Because this hormone taken by mouth could or should or might cause what?

[Inaudible]

Darkening of the skin. And don't we all like dark skin? I mean, come on, let's look at "Dancing with the Stars". Those folks have to spend, you know, 30 minutes in a spray booth where they're getting what?

[Inaudible]

Spray tans. So tan is cool, you know. And never mind the coolness of it. Is it important to have melanin in your skin?

[Inaudible]

What good is melanin?

[Inaudible]

Protection against?

[Inaudible]

Ultraviolet light. It absorbs the radiation we call UV light. So this is still being worked out. It's not available over the counter. But someday it might. It increases melanin synthesis. And relatively secondarily to that, they discovered that it also what? Suppresses appetite. So this is like the Holy Grail of pharmacology here. In other words, this is not just gold, this is platinum. Because if you have something that can cause people to get brown and lose weight at the same time, I mean, you're done. I mean you can retire. Too bad it hasn't worked out yet. Alex?

>> If albinos take this hormone, will it stimulate them to produce melanin or just because they're albinos they can't [inaudible]?

>> Steve Langjahr: Well, they don't have enough melanocytes to get by and so, yeah, it would only work in those that have decent quantities of melanocytes.

>> So, for instance, I don't know what it's called but when like on the face and hands, they're colored darker and lighter skin [inaudible]?

>> Steve Langjahr: Vitiligo, best made famous by the former Michael Jackson, is, you know, I don't know whether that's MSH related so that's my homework. Thank you. I doubt if it's MSH related. But it could be. Tantalizing question, isn't it? Anyway, let's move on. Gonadotropins. There are two of them. This is just a category. And what does the name suggest, gonadotropin? Gonads are your testes if you have them, or ovaries if you don't. And so these are the hormones that stimulate gonads. Remember the word tropin, or tropic means to stimulate. So these are two important hormones. And interestingly they're the same, chemically the same, in both sexes, even though the gonads are quite different. The names of these two tend to reflect the feminine impact for whatever reason, and number, letter F here, follicle stimulating hormone. Guess what it does? Must be a hormone. Stimulates follicles. Follicles are clusters of cells found in the ovaries and therefore quite obviously this is responsible for the development of eggs or ova, and therefore the release of ova on a monthly basis. That said, does a female child of three years old have FSH?

>> No.

>> Steve Langjahr: Are we glad that that's the case?

>> Yes.

>> Steve Langjahr: If they had FSH, they'd be ovulating at age three and giving birth at age four. Horrible thought. I know. So this hormone doesn't appear until when? Doesn't appear until puberty. And that said, if you go back chronologically over the decades of the twentieth century, the onset of puberty in females, at least in the mid-1900's was actually age 13 and 14. What do we know about the onset of puberty in females today?

[Inaudible]

All right. Ten, maybe nine even. Scary thought. Particularly because now we have children raising, giving birth to children. So what's causing this, actually I'll sidestep that. It's a physiology question, but an interesting one. Let's move on. Do men have FSH? Yes. Do they have ovaries? No. So what is their equivalent gonad. Their gonad are their testes. So this hormone has the same action, that is it stimulates the testes to release sperm. Do three-year-old boys have FSH? No. When does FSH hit the fan? Well, about 13, right? And so 13-year-old boys, can they be fathers? Sadly, that's true. The other gonadotropin is LH, a reference again to females. The word, the initials LH, luteinizing hormone, because in women this hormone stimulates the development of a structure in the ovary you'll learn about or read about called the corpus luteum. The word itself is not that descriptive. Corpus means body, luteum means yellow. Guess what color the corpus luteum is?

>> Yellow.

>> Steve Langjahr: Yellow. Doesn't tell you much but the corpus luteum is a structure. It develops on a monthly basis in the ovary and is responsible for adding on progesterone to and with the hormone estrogen, obviously important sex hormones in women. Do men have an ovary? No. Do they have a corpus luteum? No. Do they have LH? Yes. But in men LH is called instead ICSH, which breaks down into interstitial cell stimulating hormone which, of course, is the target. Interstitial cells are found in the testes and those are responsible for the male hormone, the male sex hormone, testosterone. So, to put it bluntly, fertility in women depends upon what two hormones? Fertility depends on FSH and LH. Sometimes women will have trouble conceiving so they'll go to a fertility clinic and what might be given to a female to induce ovulation?

[Inaudible]

FSH, follicle stimulating hormone. Are these two hormones equally valid, equally important in men? Yes. And, remember, they don't appear until puberty whenever that is. And, in fact, this is an important add-on, these hormones, once they're released, continue throughout life in both genders, which might at first be hard to accept because we know something rather spectacular happens in women in their late 40's. They go through what's called menopause. But it's not the absence of FSH. It's not even the absence of LH. It's the absence of follicles and therefore the inability to produce progesterone and estrogens. But, once again, this is more or less physiology. But a fair question, certainly, on an anatomy exam. If a female fails to produce FSH, obviously she's not going to O-word, she's not going to ovulate. And in men they would not produce therefore sperm. So it's a fair and reasonable question. Let's finish up with the adrenal glands. That's about as far as we can go today. The adrenal glands are also called suprarenal glands because they're situated on top of the kidneys. And you've seen them in your dissection and certainly in textbooks. The adrenal gland is somewhat pyramidal shaped, kind of mountain shaped. It's attached to, or at least touching the kidney but it has nothing to do with the kidney at all. And the adrenal glands are interesting because they're actually two glands that are wrapped around each other. And the outer part is called the medulla. The inner part is called the – excuse me, I said that wrong. The outer part is the cortex. The inner part is the medulla. So this is a cut-away view then of the adrenal glands. And here we see them superimposed and in position with the kidney and liver, just for reference. In the cat, incidentally, the adrenal glands are totally independent, that is they are away from the kidney right up against these vessels which are the vena cava and the abdominal aorta. But they do the same thing in the cat so let's knock these out. First, the adrenal medulla, which is the inner portion, quite a bit simpler, and produces essentially two hormones which are chemically very similar, not only in name, but in action. These two hormones are epinephrine which everybody knows by the trade name, the manufactured name, epinephrine is better known as what?

[Inaudible]

Adrenalin. And its cousin is norepinephrine, meaning chemically related and essentially, for our purposes, similar in action. And what are the actions, the notorious, familiar actions of at least epinephrine? What's epinephrine do? We know it's associated with fight or flight so it does what to your heart rate?

[Inaudible]

What does it do to blood pressure? And it also has a positive influence on blood sugar. All of these are supportive, that is helpful in a fight or flight scenario. So, that said, how are these hormones released? As you know, the adrenal gland is only innervated by the sympathetic system. And so when we're excited sympathetic fibers release these hormones and it prepares us for some emergency, some outpouring of energy or effort. Remember, fight or flight, essentially the same response necessary for survival. Now when we get to hormones, that is to say, as we finish off every endocrine gland, we're going to reflect or at least ask this question: What if the hormone is in excess? What if the hormone is in short supply? Those are very different scenarios and so we should emphasize and consider both. What about hypersecretion, what does that even mean? Too much. And this is a condition associated with a tumor of the adrenal medulla, something called pheochromocytoma. And therefore you have too much, too much epinephrine and too much norepinephrine. What would be the symptoms? Well, it's obvious. You'd have too much of this, too much of this, and too much of this. In other words, increased HR, what's that, human resources? No?

[Inaudible]

Heart rate. And what's hyperglycemia mean?

[Inaudible]

High blood sugar. And what's hypertension?

>> High blood pressure.

>> Steve Langjahr: High blood pressure. Now would this be serious? Everybody that has hypertension doesn't have pheochromocytoma. But, of course, this could be an indication of too much epinephrine. Speaking of hypersecretion, how do you deal with it, medically speaking? Basically this gland is making too much of that hormone. What's the surgical obvious approach to reducing the supply of a given hormone when it's in excess?

>> Remove it.

>> Steve Langjahr: Take out the gland. And that'll work, although when you take out the adrenal medulla you're also going to take out at the same time the adrenal cortex. Now that's the bad news. But, after all, how many adrenal glands do you have?

>> Two.

>> Steve Langjahr: Two. So could you take out one and reduce the supply of epinephrine and still have enough and still at the same time maintain the adrenal cortex? Yes. So surgery sometimes is an option for pheochromocytoma, especially if it is the result of a tumor and that tumor can be located in the one or the other of the adrenal glands. What's the opposite of hypersecretion? It's hyposecretion. And the simple matter here is that it doesn't usually produce any problems. In other words, people don't complain or die of too little epinephrine. So it's non-problematic. Moving to the adrenal cortex which is the outer layer. I wish we could say this is easy but actually this is quite a busy layer. In fact it has three parts, three zones, and each of these produces very different hormones with very different actions and therefore very different impacts. So here's the adrenal medulla down here which we just finished with. So now we're going to the adrenal cortex. It has three layers. Let's go from the outside in. The outside layer, which is colored orange here for no good reason, is called the zona glomerulosa which is kind of a romantic sounding word but actually glomerulus reminds us of a phrase or a structure in the kidney. But actually the word glomerulus means ball, B-A-L-L. And that's because the cells here are kind of ball-like. They produce a family of hormones called mineralocorticoids. That's the family name. The specific hormone produced here, the

specific kind of mineralocorticoids, is aldosterone. And its target is what? What does this hormone target? What is its target? It's the kidney. And it increases, it improves what? Sodium and water retention. And that's all you need to know for anatomy. Next the zona fasciculata, a word that we've used before, a fasciculus which means a bundle. So that's the name. These cells are kind of bundled into tall columns. There's a family of hormones here, all of them steroids. Incidentally, what do you think this final three letters is, -oid, -oid, -oid? It's actually a reference to the word steroid which is a fat-like compound. So glucocorticoids are the general name given to these compounds. And the one that's important here, the one you need to know by name is cortisol. Cortisol has many actions. Indeed, it's often described as the most important stress hormone in the body. It promotes the manufacture of glucose from what source? From fat and protein. And when would glucose be useful? S-word. Stress. So this hormone tends to respond to stress and provides glucose for those stressful encounters. But its main claim to fame is its application, its pharmacological application, meaning its use as a drug. If you have any hormone on the shelf at home, it's probably this one. And you can get it without a prescription. It's called cortisone. Not in the pill form but in a cream or ointment, maybe even a spray. And why do people put cortisone on their skin?

[Inaudible]

It is anti inflammatory. It's anti-itch. And so it has a lot of therapeutic value in skin lesions, well, you know, mosquito bites and stuff like that. Very useful a an anti inflammatory agent. And it can also be used interarticularly. Do coaches, do physicians inject cortisol into the knee joint? Would that reduce inflammation? Would it get them back on the playing field? Yes. Then the zona reticularis, innermost, which is basically the home or the source of so-called androgens. The word andro-, the prefix andro-, means male. So androgens are generically male sex hormones including and mostly testosterone. Now don't get me wrong, most men get most of their testosterone from what obvious source? Testes. But they also get a little extra kick from their what? Adrenal cortex. With that said, do females make testosterone? Yes. And where do they make it? They make it in their adrenal cortex. There are many effects of testosterone. But it's most famous and useful effect is that it maintains the condition of the gonads and, especially it affects the brain as it induces or supports libido or sex drive. So if a woman comes in complaining of lack of libido, what might she be prescribed? What hormone might she be given? Testosterone. Hopefully not too much. Because we don't want to go overboard on that. We don't want to create a bodybuilder out of a female. Although you can see them on covers of magazines. Let's finish up. Cortical dysfunctions. All three of these could be in high or low levels but let's go to two basic syndromes here. One was described by a physician long ago. His name was Cushing so it's called Cushing syndrome. But that doesn't tell you much, in fact, it's a useless name. So it's real name should be hypersecretion of the adrenal cortex. And it usually means that we have fluid retention, weight gain, and also a lot of cortisol which produces poor resistance or reduced resistance to infection. And in women too much testosterone would cause what? Masculinization. In men too much testosterone would go unnoticed. In fact it would be worshipped. But nevertheless, in women, not so pretty. In fact, here's a woman who made a profession as a model and then alter she developed Cushing syndrome. You can't see her entire fact but it's not nearly as pretty. And the reason this was done in profile is that this develops. A lot of adiposity develops between the shoulder blades. And it's a symptom that's not very flattering. It's called the buffalo hump. And unless you missed this day in anatomy, you'd know that that was a case of what? Cushing syndrome. So that's why a physical examine is important with the clothes off so we can see what's going on throughout the entire body. How do you deal with this? How do you deal with any hypersecretion? We've already said: Too much hormone; identify the source; cut out the gland or at least somehow keep it from producing. The opposite is hyposecretion. And I don't know why Cushing didn't catch this but somebody else came along and figured it out. His name was Addison. Well, you can call it that if you want but it's basically too little, too little of this hormone, aldosterone. And also too little of this hormone, cortisol. This is very serious and leads to massive quantities of water and sodium depletion. And as you're losing sodium can be lethal. How do treat hyposecretion of any hormone? Very easy. That hormone's not secreting. How do we fix it? Give them the hormone by pill form. It's called HRT, initials standing for hormone replacement therapy. Somebody's diagnosed with Addison disease, what are they going to get by mouth every day? They're going to get aldosterone and cortisol. Here's a very famous U.S. president and maybe you now it's John F. Kennedy. This is him when he was a senator before he was president and he had, although he hid from public knowledge, he had what? Addison disease. Doesn't he look a little gaunt? And a little dehydrated shall we say. And then he got treated and then he became president. And so quite a bit, well, more normal looking I guess you could say. So can HRT be converting, that is can it convert somebody who is hyposecretion into a normally secreting or normally functional individual with any given hormone? Yes. So that's as far as we can go. We went too far I suppose but hope you have a great day. See you next time.