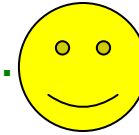


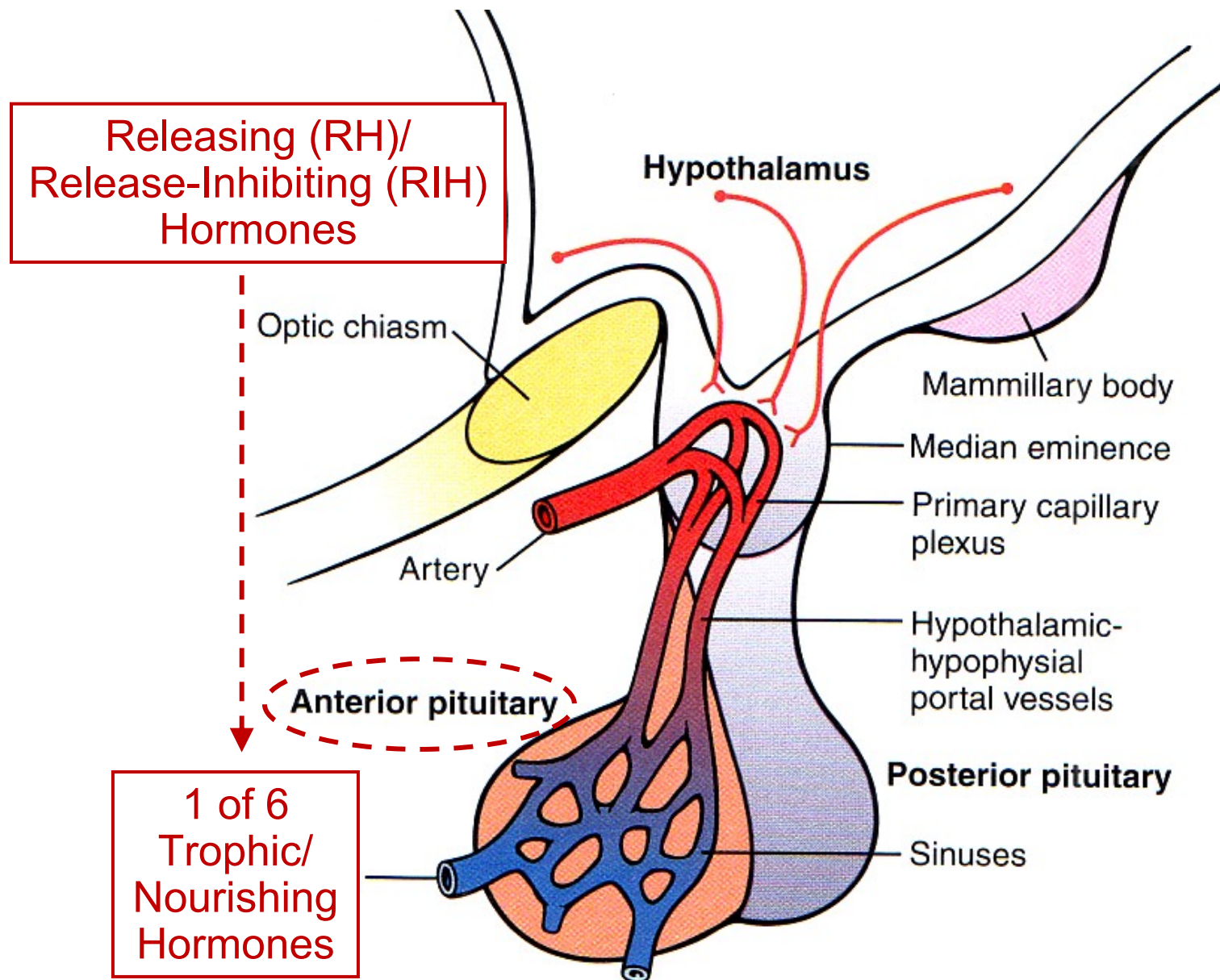
## Lecture 13

Lucky 13! Hooray!! Dr. Garrett this  
Thursday! Dr. Kaplan next Tuesday!!...

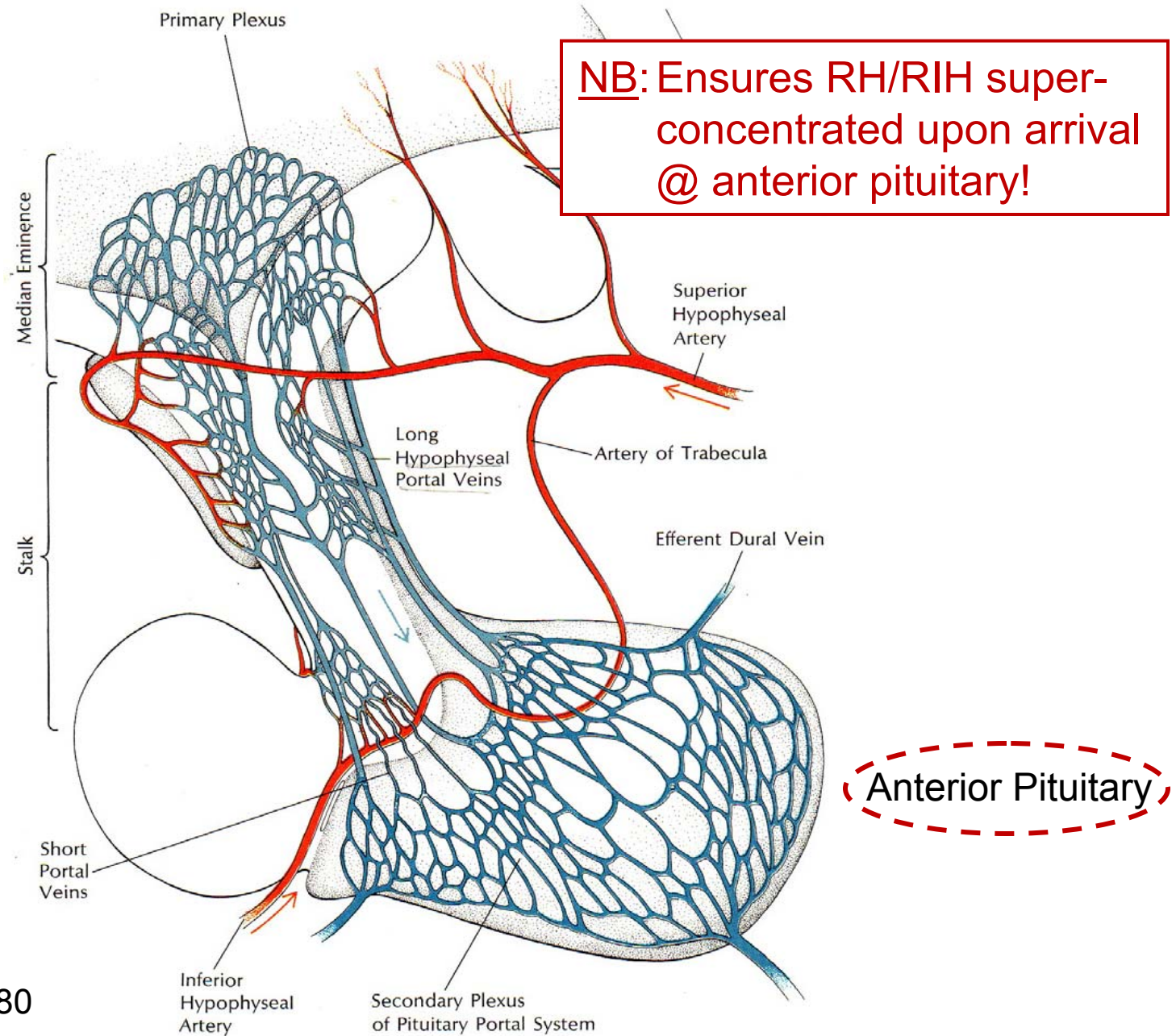


- I. Quiz 4** Covering **CV physiology**. Q?
- II. Endocrinology Connections** from Lecture 10
- III. Med Physiol News** Sex Allergy? Mom's eggs execute dad's mitochondria? *Science News*
- IV. Reproductive Physiology Primer** ch 81 + 80 G&H + LS + ...
  - A. Female reproductive system fig 81-1, 81-2
  - B. Ovarian hormones +FB: estrogen & progesterone pp 991-4
  - C. Follicle growth & ovulation mechanism fig 81-4, 81-5
  - D. Plasma gonadotropin & ovarian hormone [ ] in female sexual cycle fig 81-3
  - E. Female sexual cycle, menstruation fig 81-3, 81-8
  - F. Estrogen [ ] throughout lifespan, menopause fig 81-12
  - G. Birth control techniques L Sherwood + G&H
  - H. Male reproductive system fig 80-1 A & B
    - I. Sperm & development fig 80-2, 80-7, 80-3, 80-4, 80-5
  - J. Feedback regulation in males fig 80-10
  - K. Plasma testosterone [ ] throughout lifespan fig 80-9

# ***Hypothalamus – Anterior Pituitary Vascular Connection***



# Capillary-Venule-Capillary Circulation







Infundibulum/stalk

Long  
hypophyseal-  
portal veins

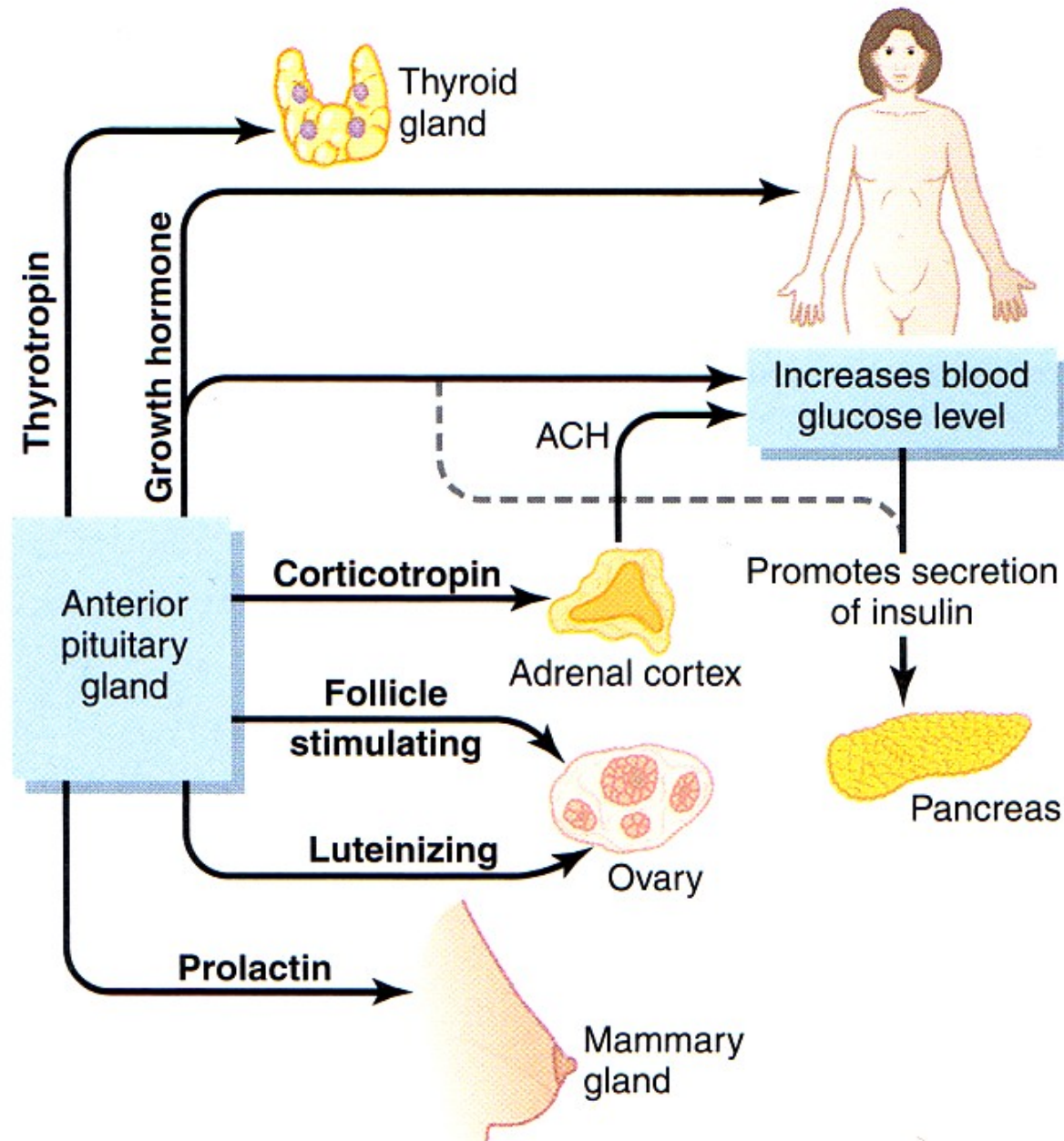
Pituitary  
removed!

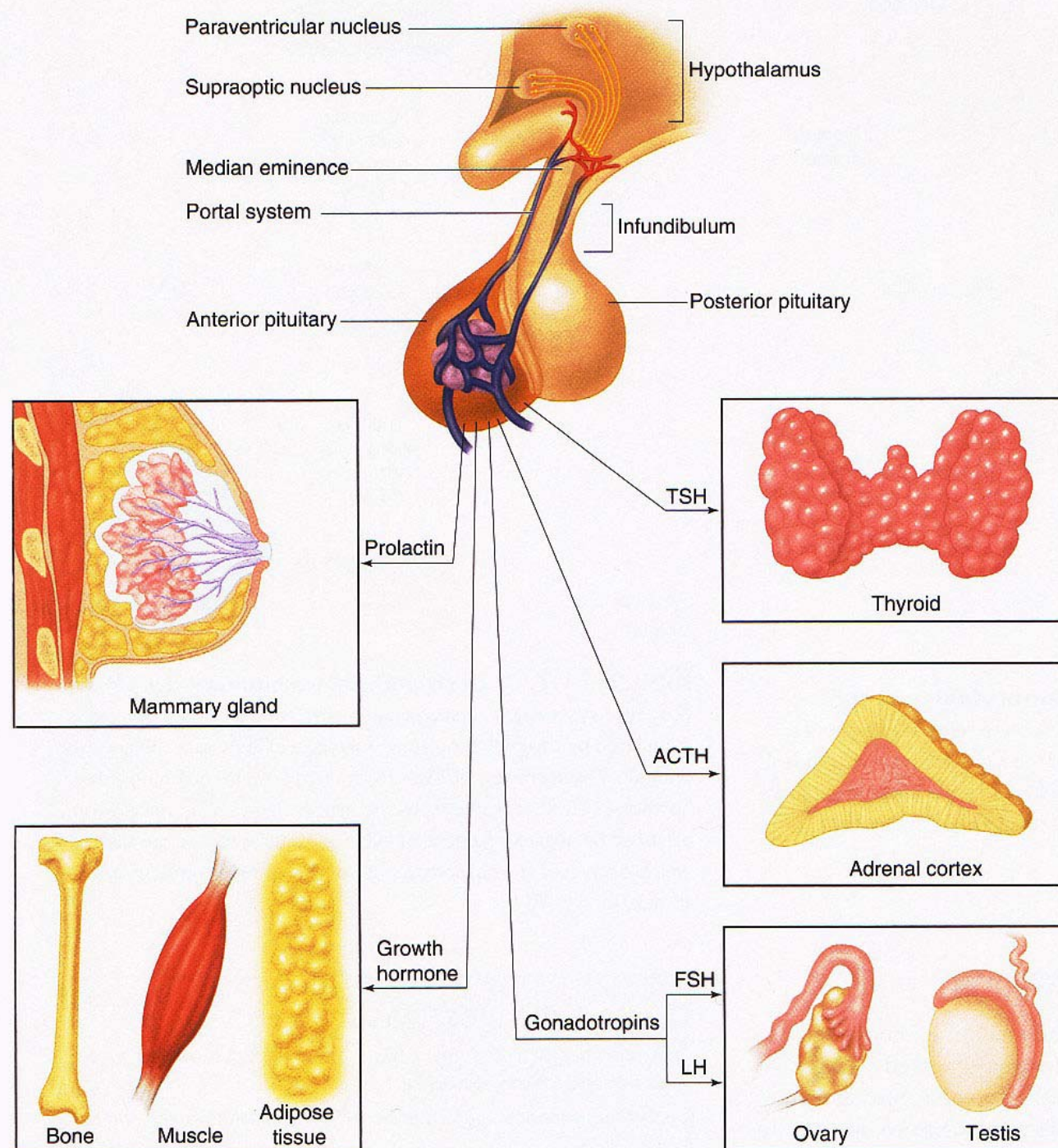
Krieger & Hughes  
1980

1 mm

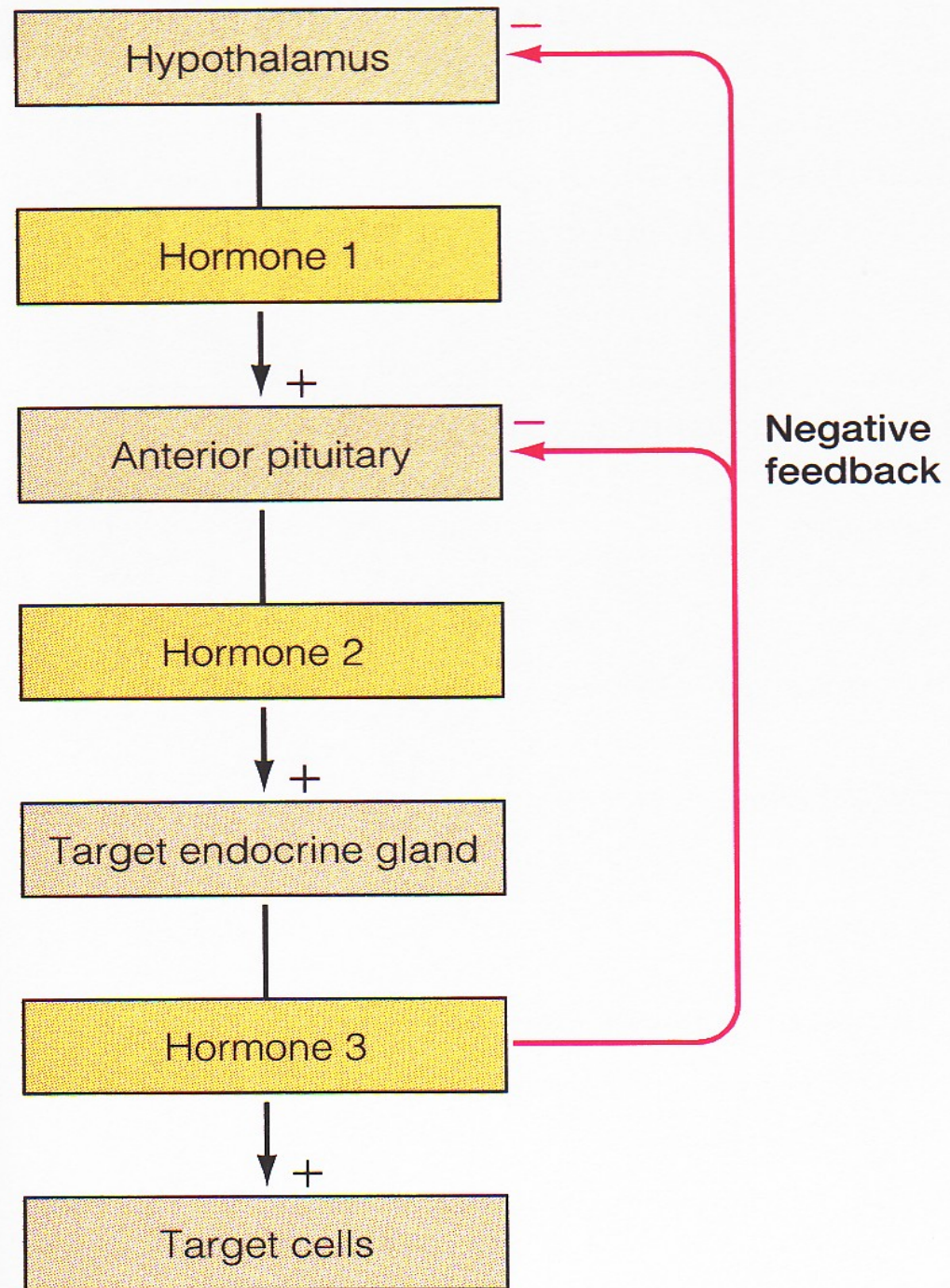


# *Anterior Pituitary Metabolic Functions*

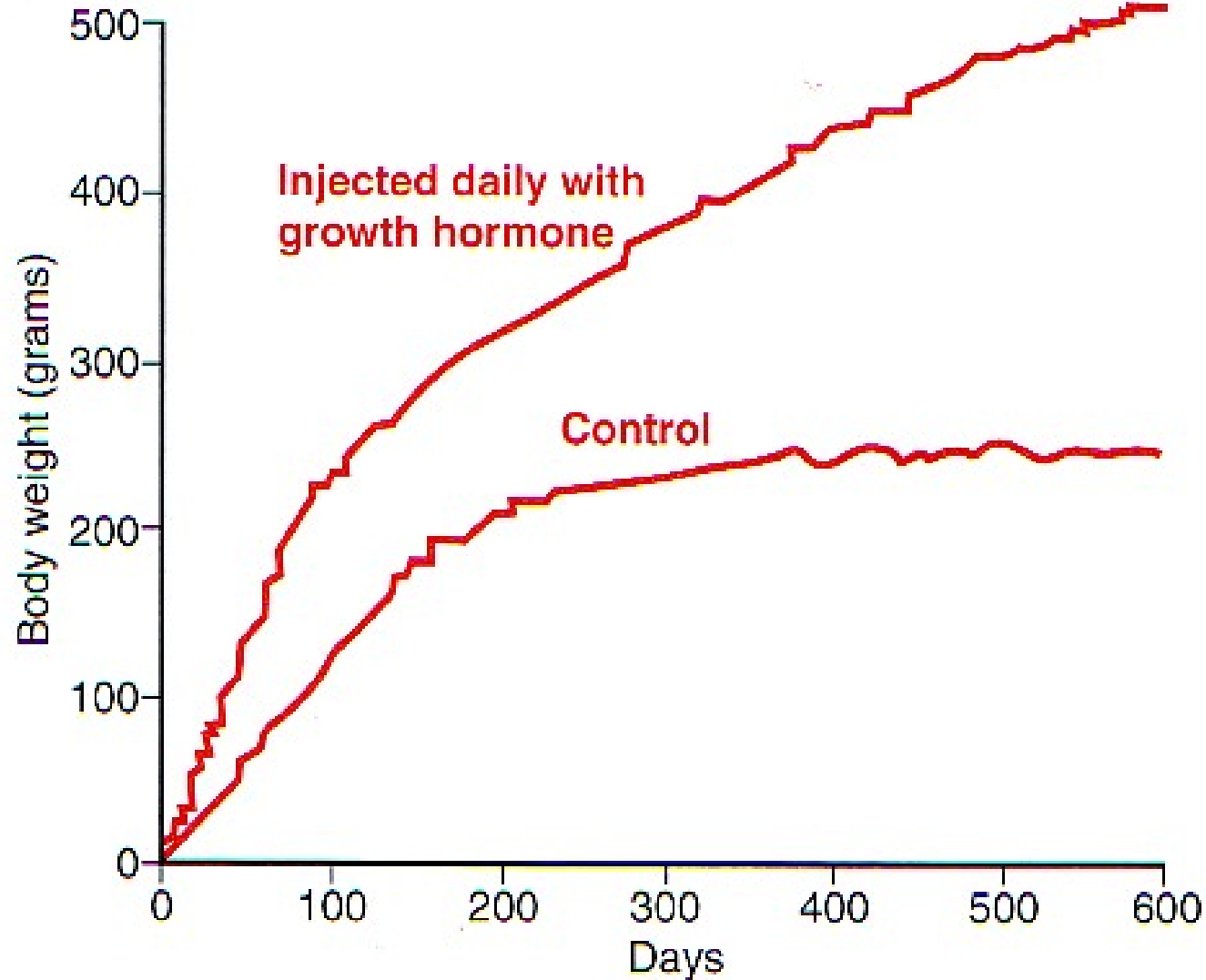








## ***GH, a Protein Hormone (191 AA)***



**FIGURE 75-5**

Comparison of weight gain of a rat injected daily with growth hormone with that of a normal littermate.



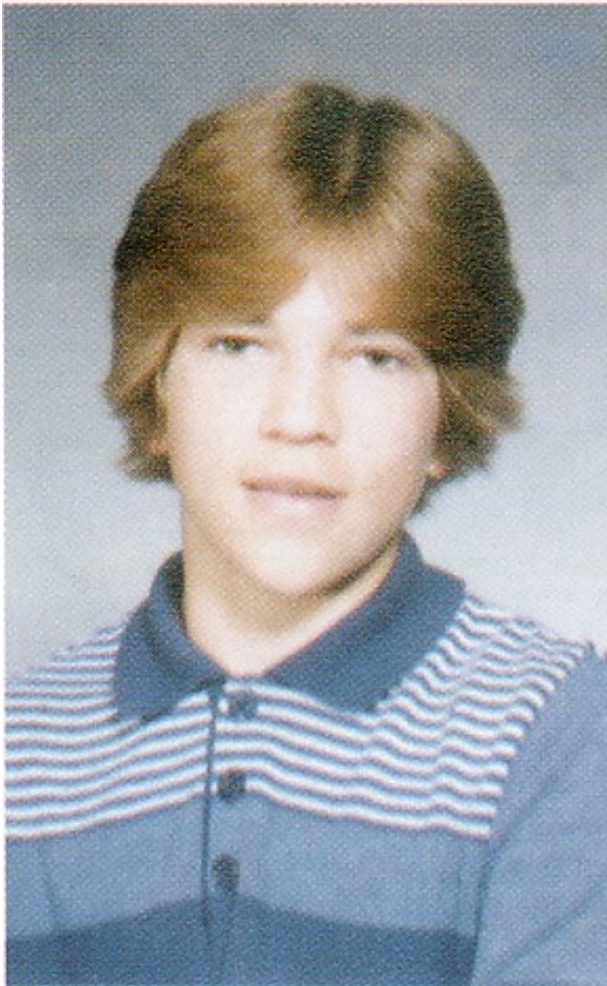


LS2 2006



# *Progression & Development of Acromegaly*

Age 13



Age 21



Age 35







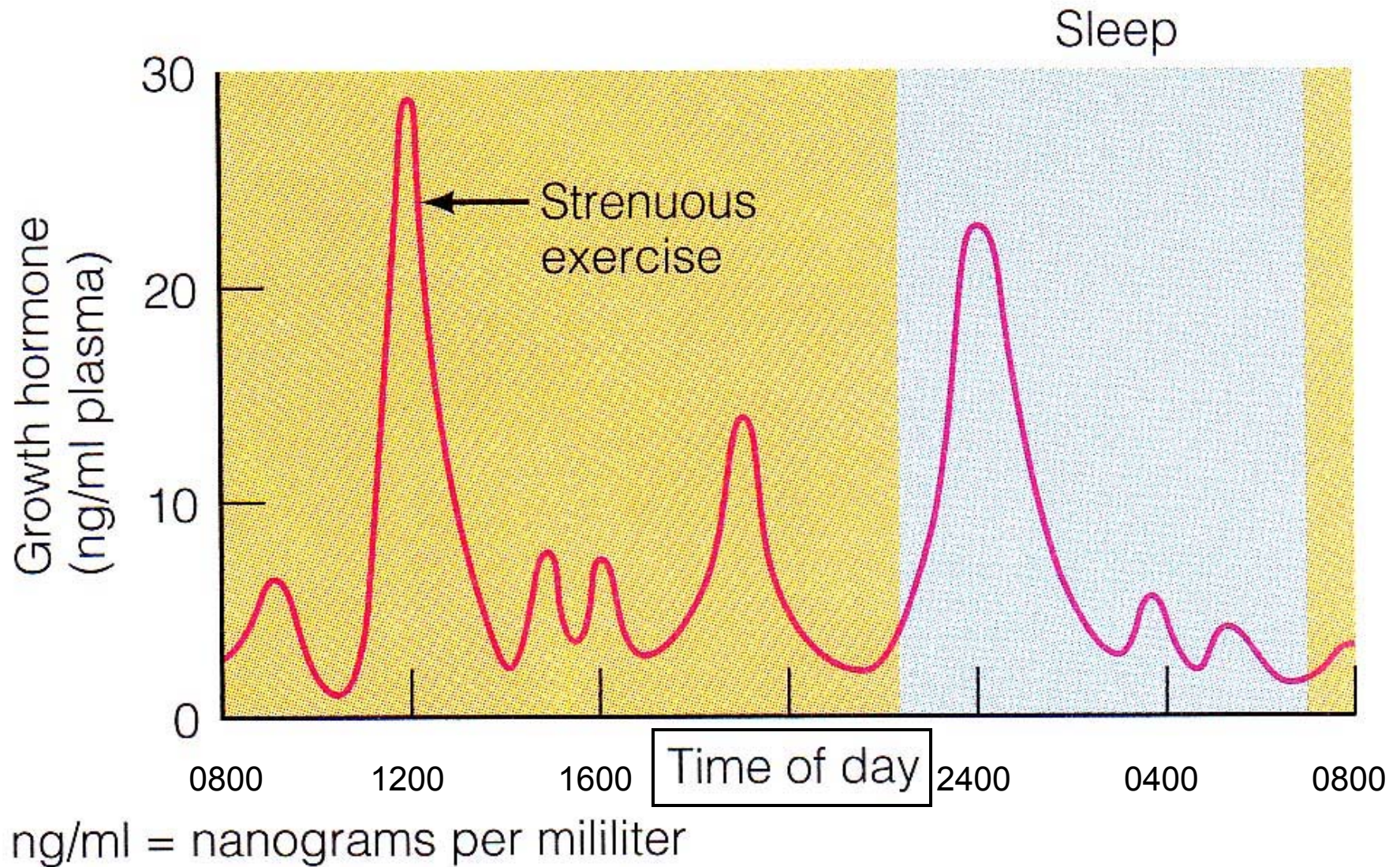
Growth Hormone  $\equiv$   
Somatotrophic Hormone  
*Body Builder's Dream?*

## ***GH/STH Effects: Insulin Resistance/Type II Diabetes?***

- ↑ Amino acid uptake & protein synthesis
- ↑ Lipolysis & fatty acid mobilization
- ↓ Glucose uptake  
(skeletal muscle & adipocytes)
- ↑ Glucose production  
(liver glycogenolysis)
- ↑ Insulin secretion



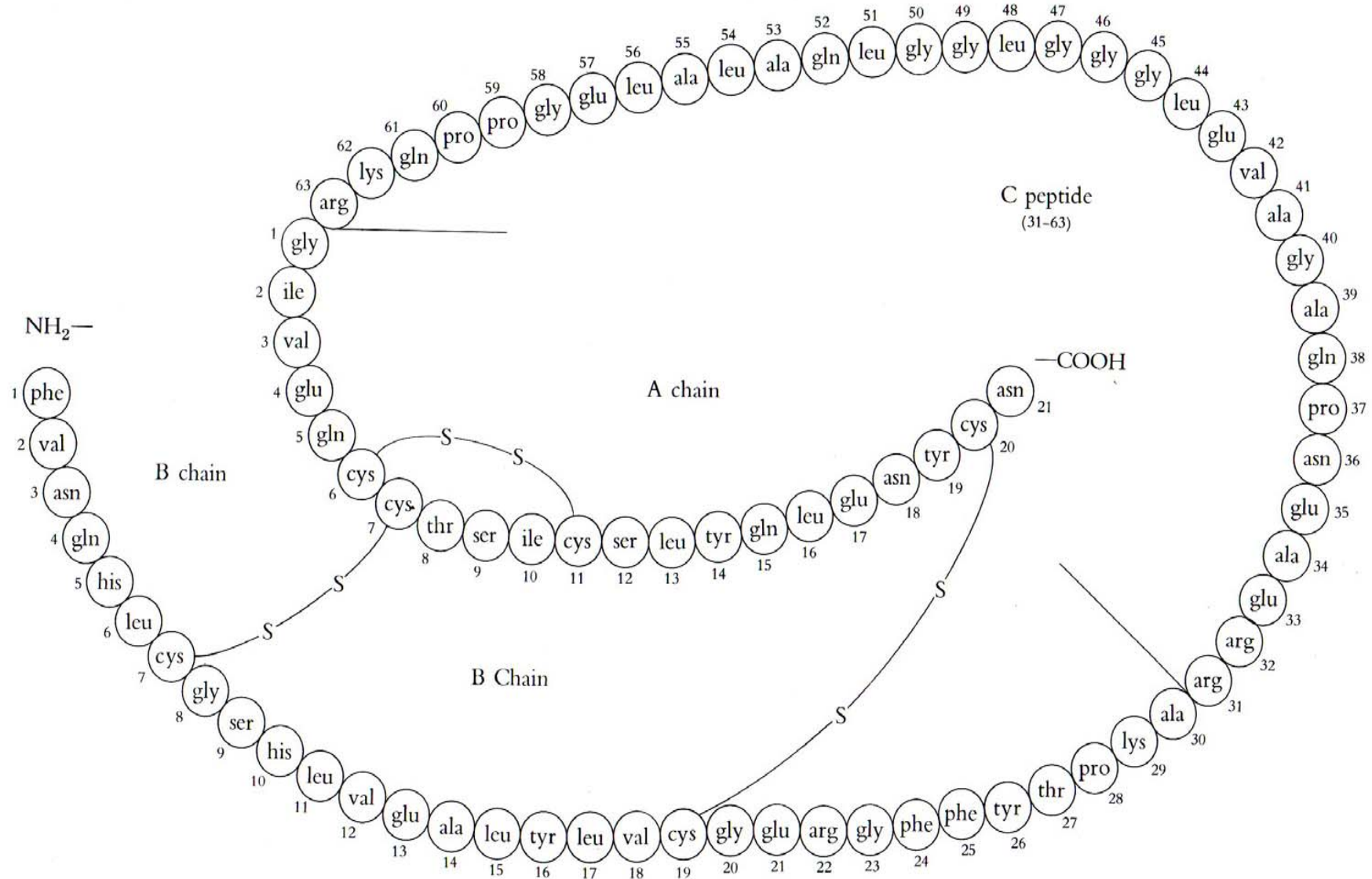
## *Increase GH naturally with exercise & sleep!!*



cf: G&H 2011 fig 75-6

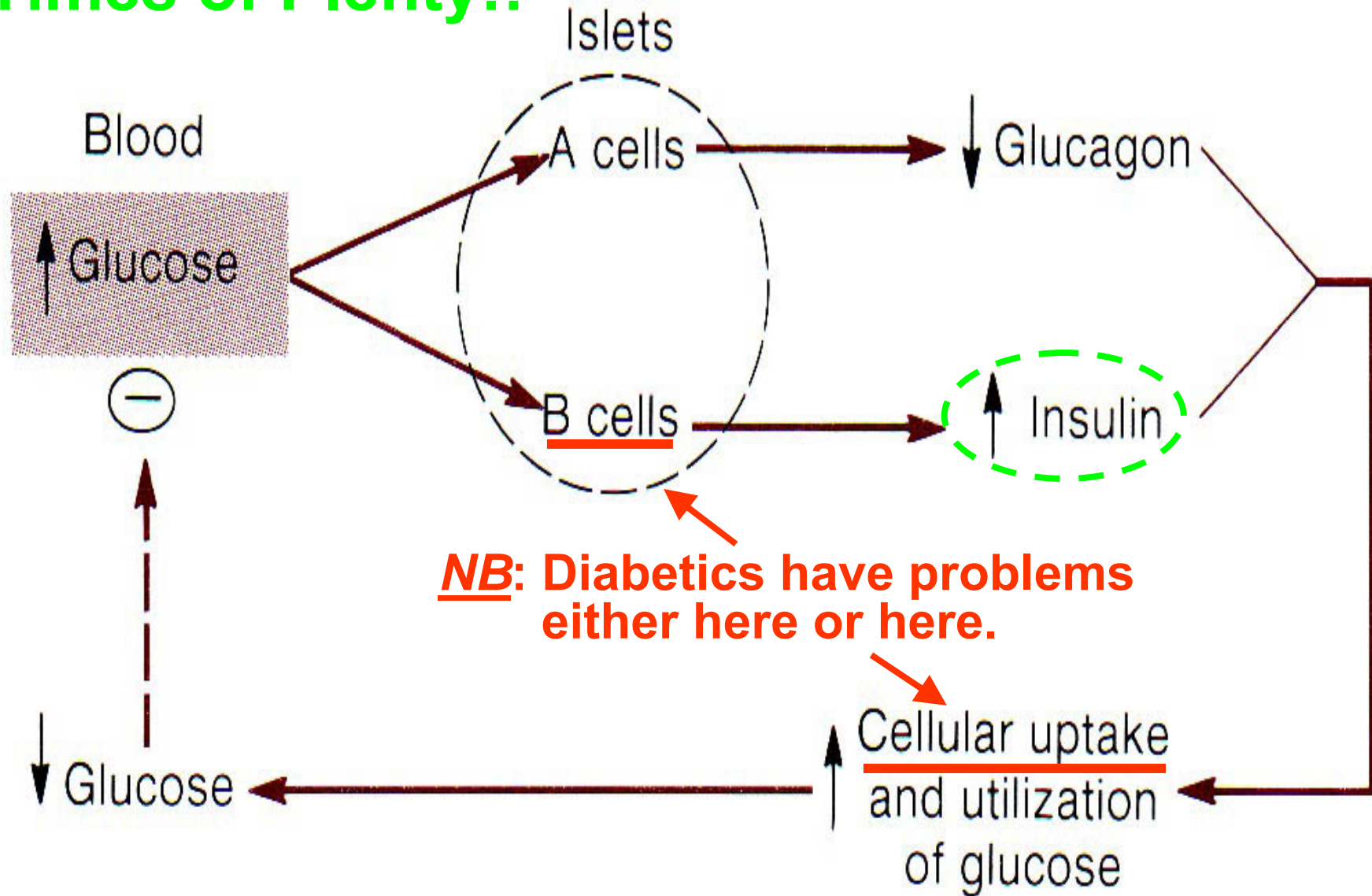


# Proinsulin with C-Connecting Peptide



**FIG. 10-4.** Amino acid sequence of a mammalian proinsulin molecule. Note how the insulin molecule can be formed by cleaving this polypeptide chain at two locations to liberate the C peptide.

# Times of Plenty!!





Glucose:  
*Sugar in Blood*

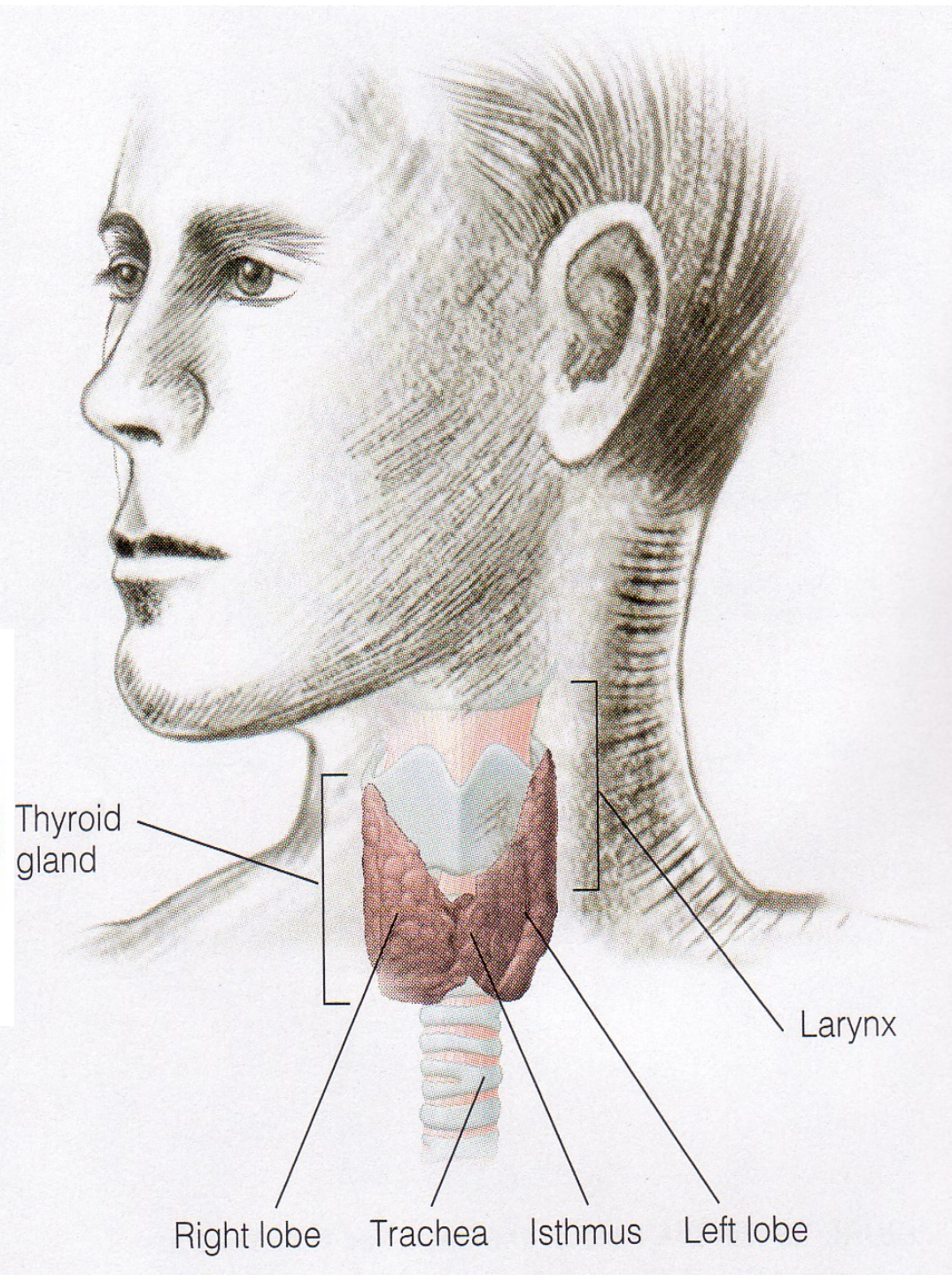


*Normal: 70-99*

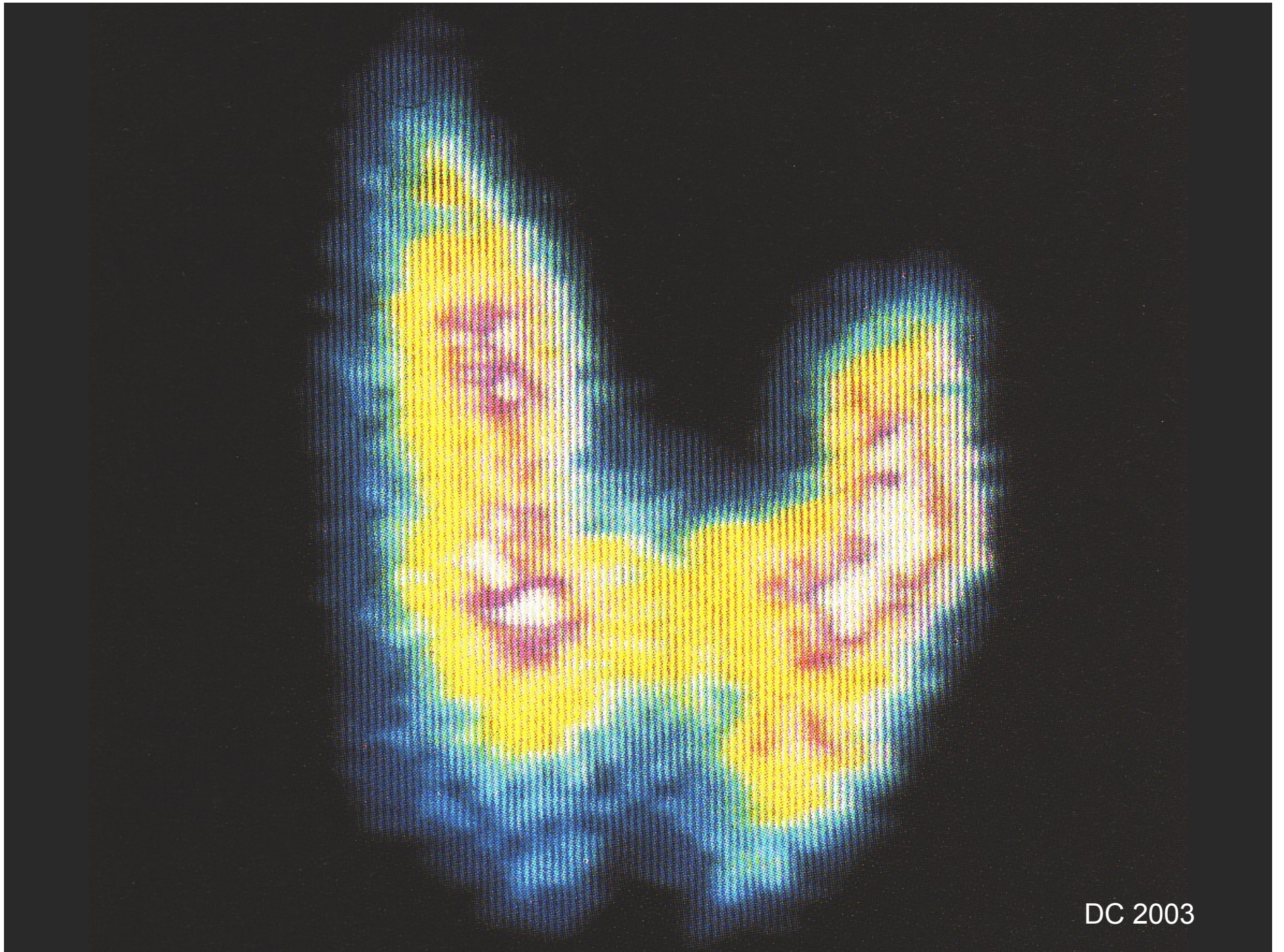
*Pre-Diabetes: 100-125*

*Diabetes:  $\geq 126$  mg/dL*









DC 2003



Thyroid  
cartilage  
of larynx

Cricoid  
cartilage  
of larynx

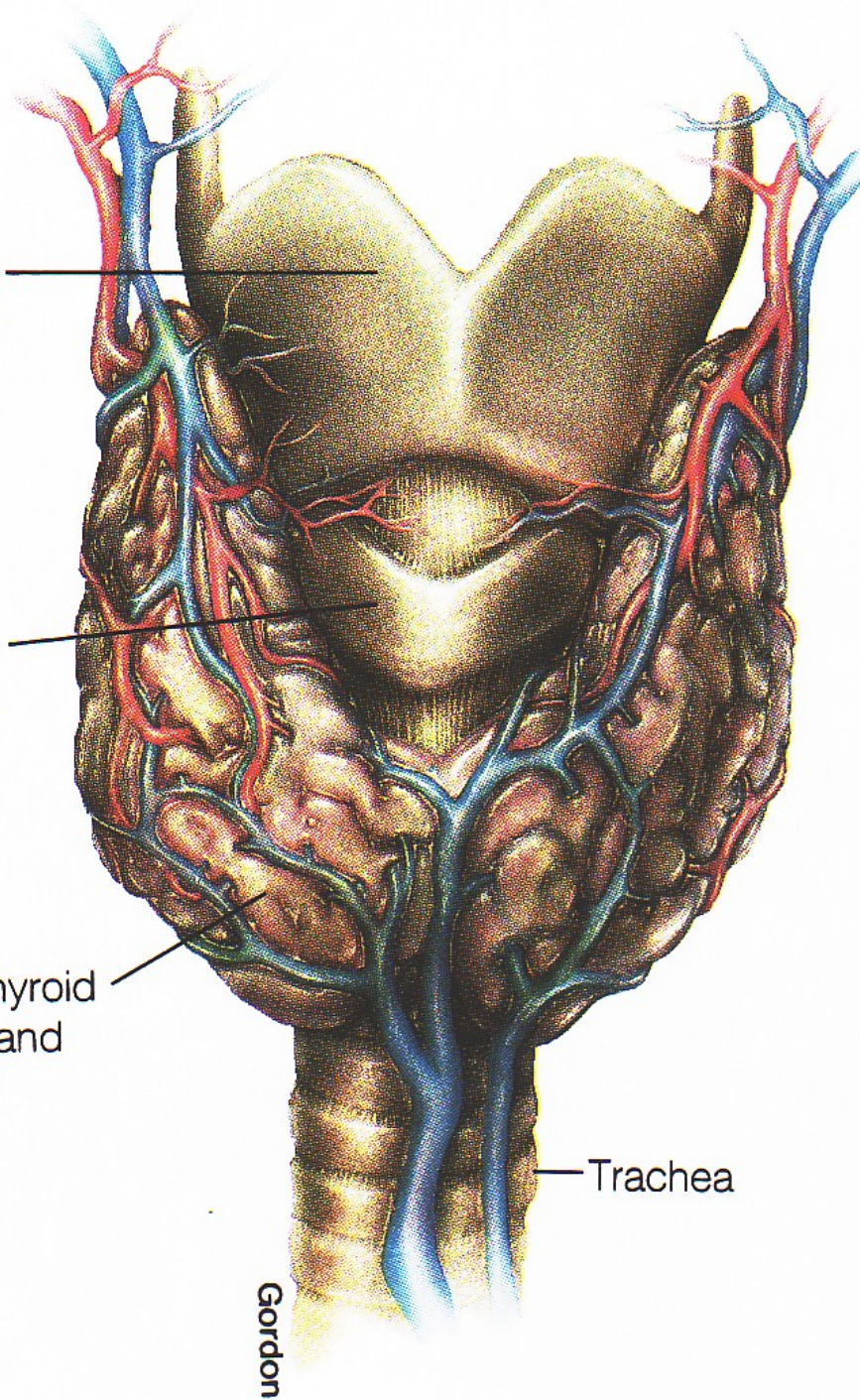
Thyroid  
gland

Trachea

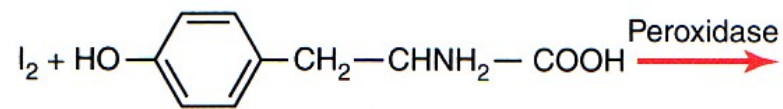
Gordon

(a)

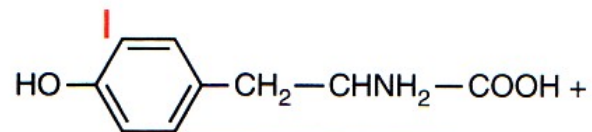
DC 2003



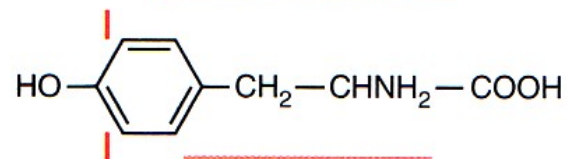




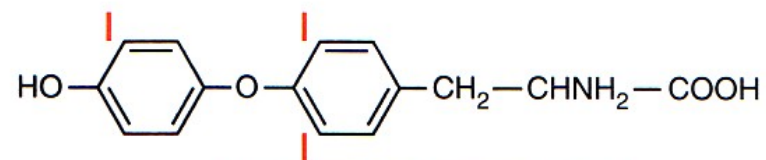
**Tyrosine**



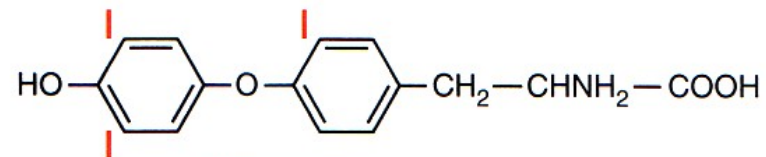
**Monoiodotyrosine**



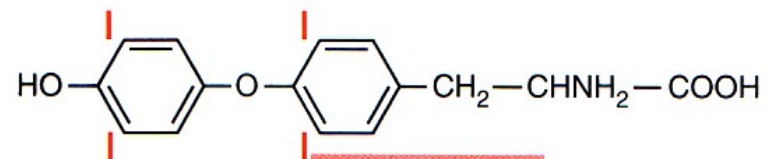
**Diiodotyrosine**



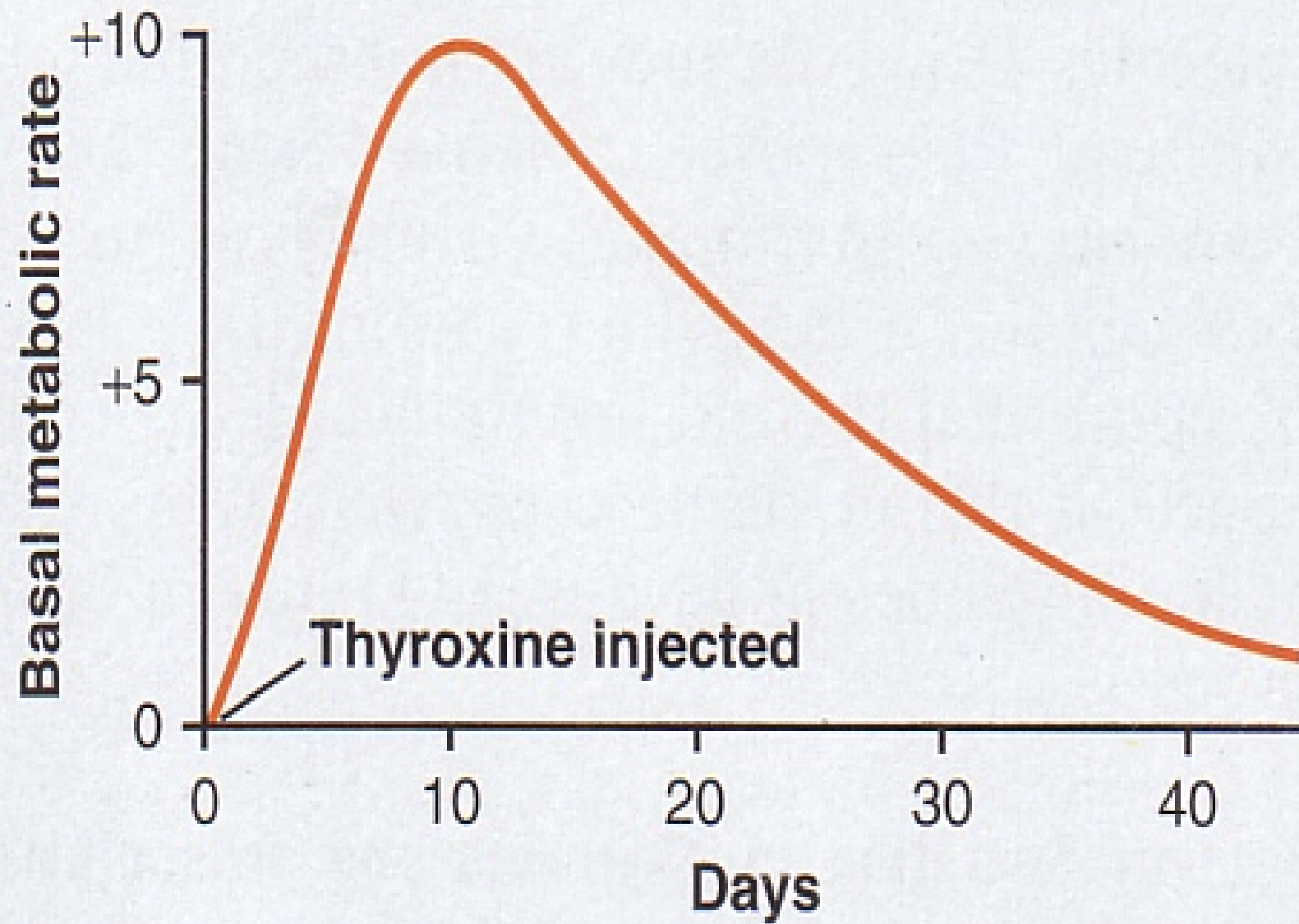
**3,5,3'-Triiodothyronine (T<sub>3</sub>)**



**3,3',5-Triiodothyronine (RT<sub>3</sub>)**



**Thyroxine (T<sub>4</sub>)**





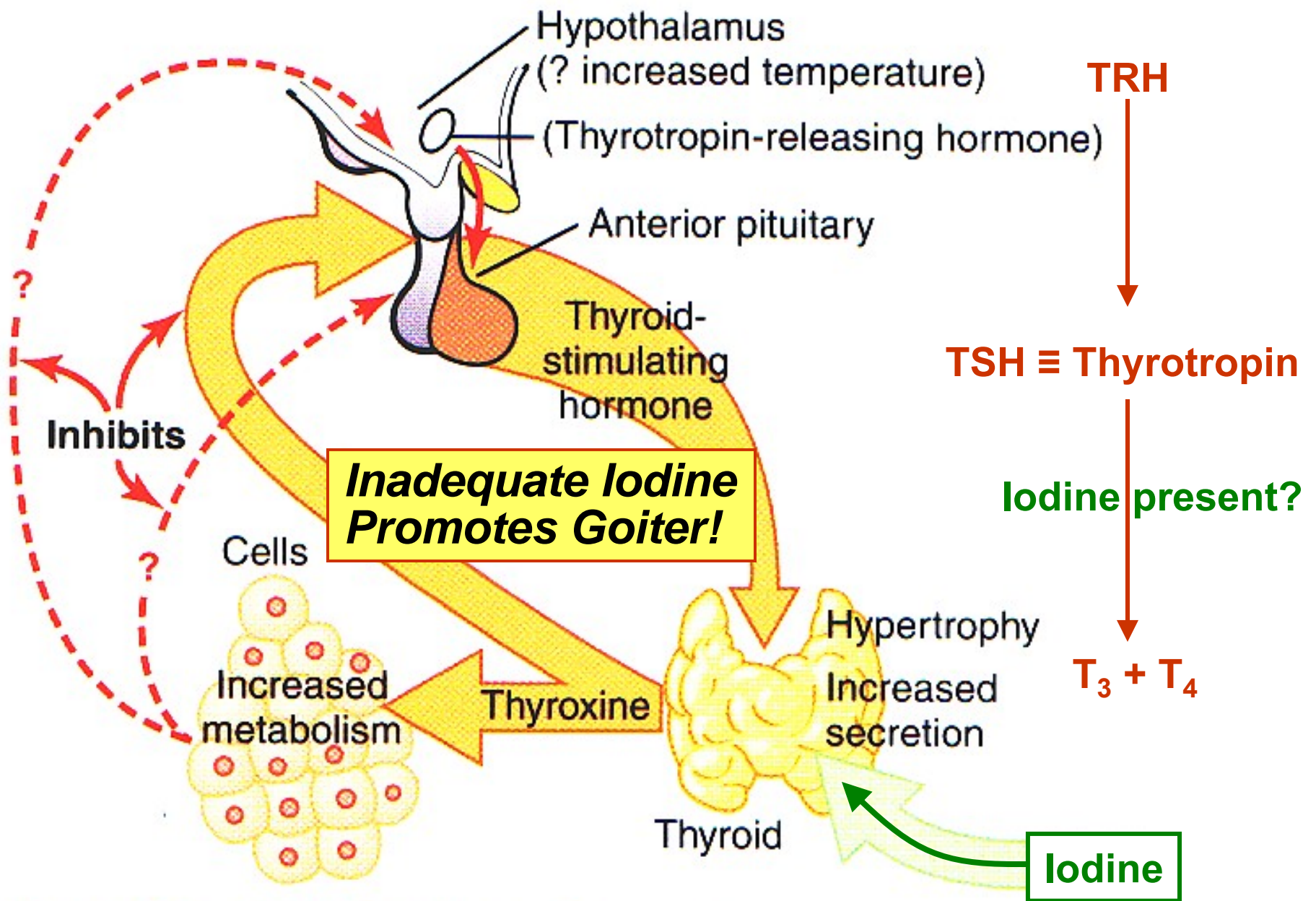


Figure 76-7 Regulation of thyroid secretion.





DC 2003



cf: G&H  
2011  
fig 76-8



DC  
2003



Near  
absence of  
thyroid-  
hormone  
function +  
myxedema



**Figure 76-8.** Patient with myxedema. (Courtesy of Dr. Herbert Langford.)

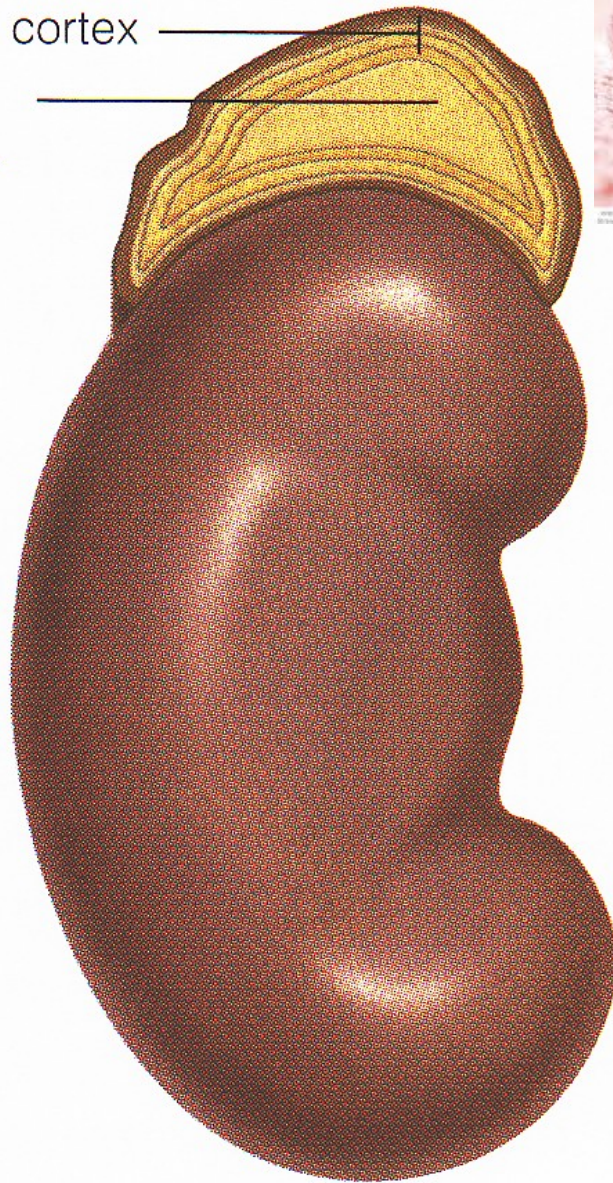


## Adrenal gland

Adrenal cortex

Adrenal medulla

Kidney



Scoop of  
ice cream on  
North pole!

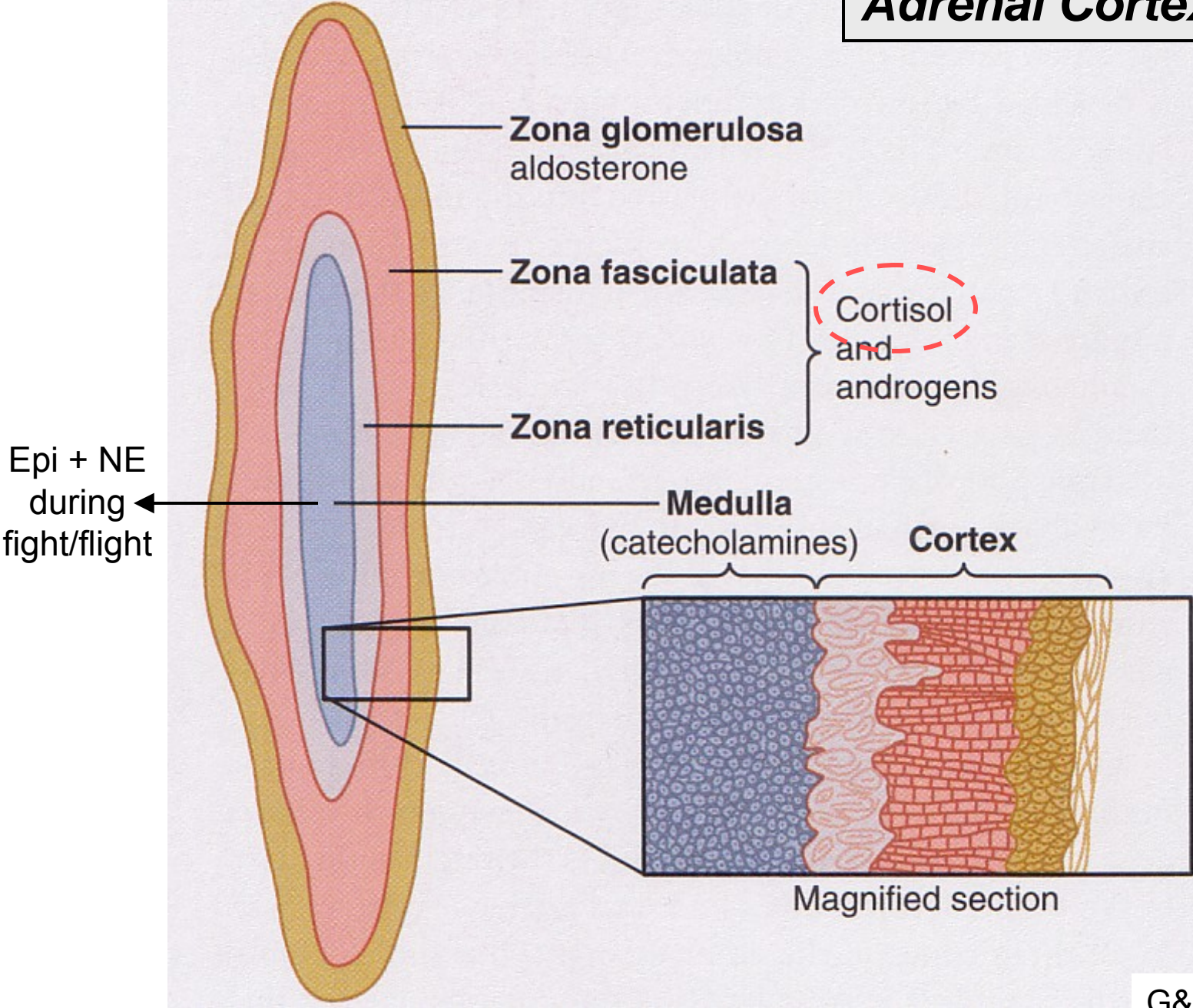
### FIGURE 13-12

#### Adrenal Gland

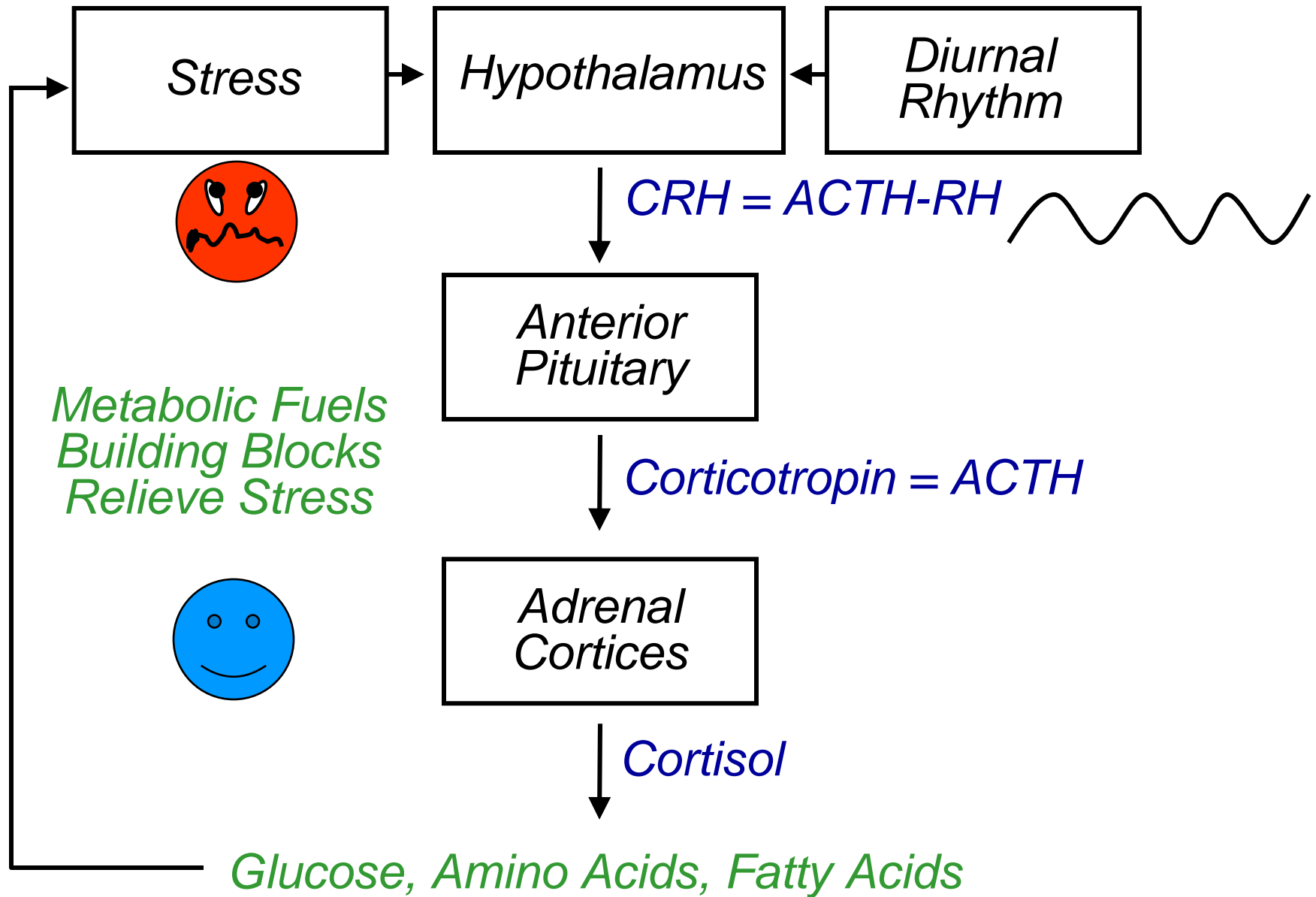
The adrenal glands sit atop the kidney and consist of an outer zone of cells, the adrenal cortex, which produces a variety of steroid hormones, and an inner zone, the adrenal medulla. The adrenal medulla produces adrenalin and noradrenalin.



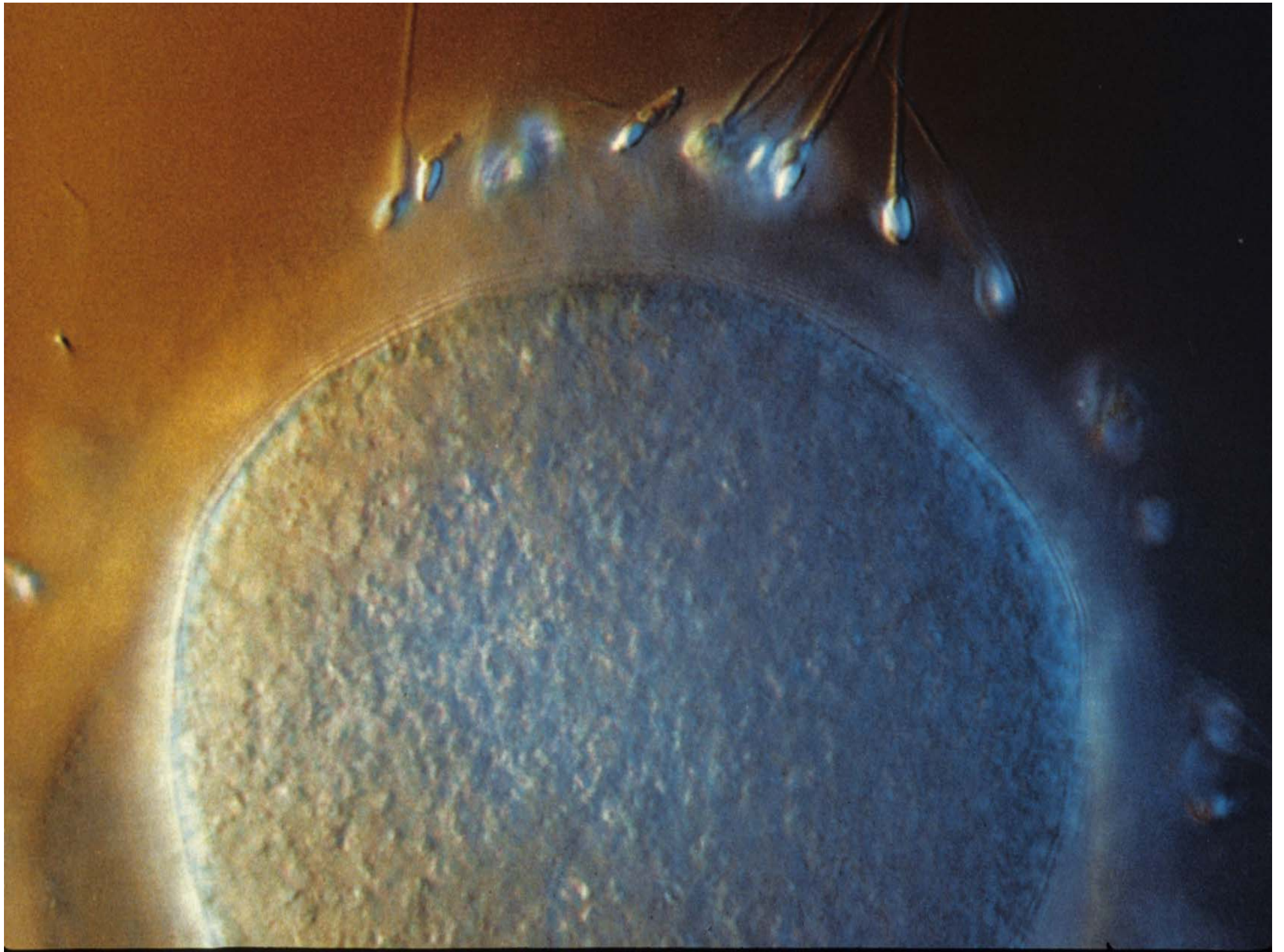
# Adrenal Cortex Zones







SOURCE: Modified after D Chiras 2003





# Biomedicine

## Sex allergy: No laughing matter

The phrase “Not tonight, dear” may be a deadly serious matter for women who suffer from an allergy to their husband’s seminal fluid, the liquid that carries sperm. In rare cases, such an allergic response can cause death.

The first case of an allergy to human seminal fluid was documented in 1958. Since then, the disorder has been diagnosed in a small number of cases. However, allergists believe the disorder is not readily recognized by gynecologists.

Some women with this condition report a dramatic, whole-body reaction to seminal fluid. Their symptoms include wheezing, vomiting, diarrhea, unconsciousness, or complete circulatory collapse. Other women experience a localized reaction, such as vaginal burning or swelling.

Researcher Jonathan A. Bernstein of the University of Cincinnati College of Medicine and his colleagues decided to study the prevalence of the disorder. They administered a questionnaire to 1,073 women who had reported symptoms consistent with the allergy.

Bernstein’s team found that 12 percent of the women they studied met the diagnostic criteria for an allergy to seminal fluid. This result indicates that the disorder is much more common than previously suspected. The team reports its findings in the January ANNALS OF ALLERGY, ASTHMA, & IMMUNOLOGY.

Allergists can treat the condition, the researchers point out. Regular injections of purified seminal proteins can prevent the relationship-stopping symptoms, says Bernstein. — K.F.



**Semen? G&H p 976**

**60% seminal vesicle fluid -  
mucoid, PGE<sub>2</sub>, fructose,  
fibrinogen**

**30% prostatic fluid -  
NaHCO<sub>3</sub>, clotting enzyme,  
Ca<sup>2+</sup>, profibrinolysin**

**10% sperm + vas deferens fluid**



# Mom's eggs execute Dad's mitochondria

In "Hamlet," Rosencrantz and Guildenstern deliver a letter to the rulers of England that carries the ill-fated duo's own death sentence. Perhaps Shakespeare knew a bit about reproductive biology.

Scientists have now found that during a sperm's creation, its mitochondria—energy-producing units that power all cells—acquire molecular tags that mark them for destruction once the sperm fertilizes an egg. This death sentence, a protein called ubiquitin, may explain why mammals inherit the DNA within mitochondria only from their mothers, a biological curiosity geneticists have used to trace human evolution (SN: 2/6/99, p. 88). The finding may also have implications

species mitochondrial inheritance. Sperm mitochondria sometimes avoid destruction when two different species of mice mate, and Schatten's team has shown this also holds true in cattle. It's hard to understand how an egg distinguishes between paternal mitochondria of closely related species, says Schon.

When paternal mitochondria escape destruction in normal mating, the resulting embryo may suffer. Schatten notes that a colleague has found sperm mitochondria in some defective embryos from infertility clinics.

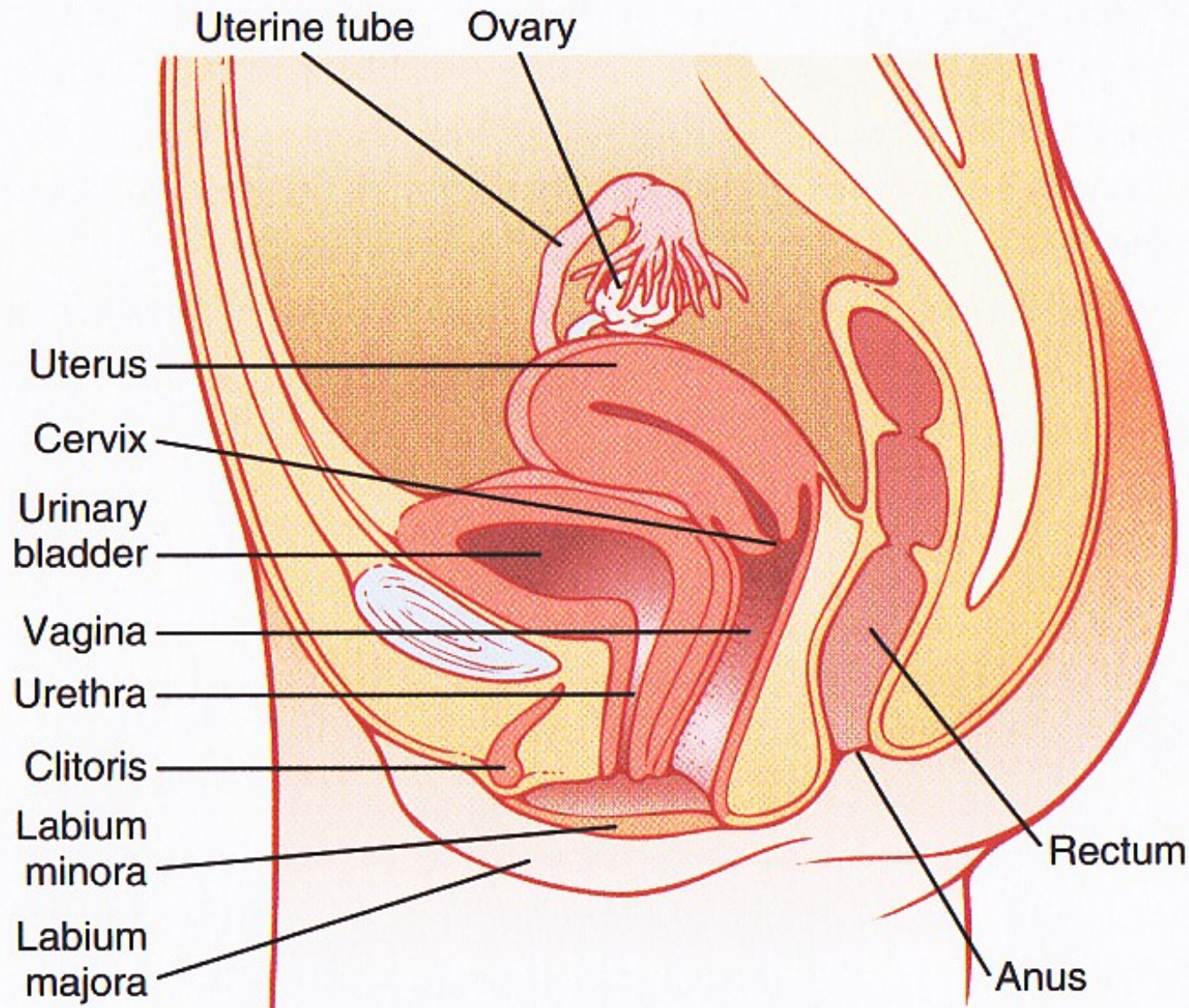
The success of cloning may depend on an egg's ability to destroy foreign mitochondria. In the technique used to create



May Day! May Day! We're doomed!!



# ***Female Reproductive System***



## 1<sup>o</sup> Female Hormones

① Hypothalamus

⊖ GnRH ⊖

② Anterior Pituitary

Gonadotropes/Basophilic Cells

FSH/Follicle Stimulating Hormone

LH/Luteinizing Hormone

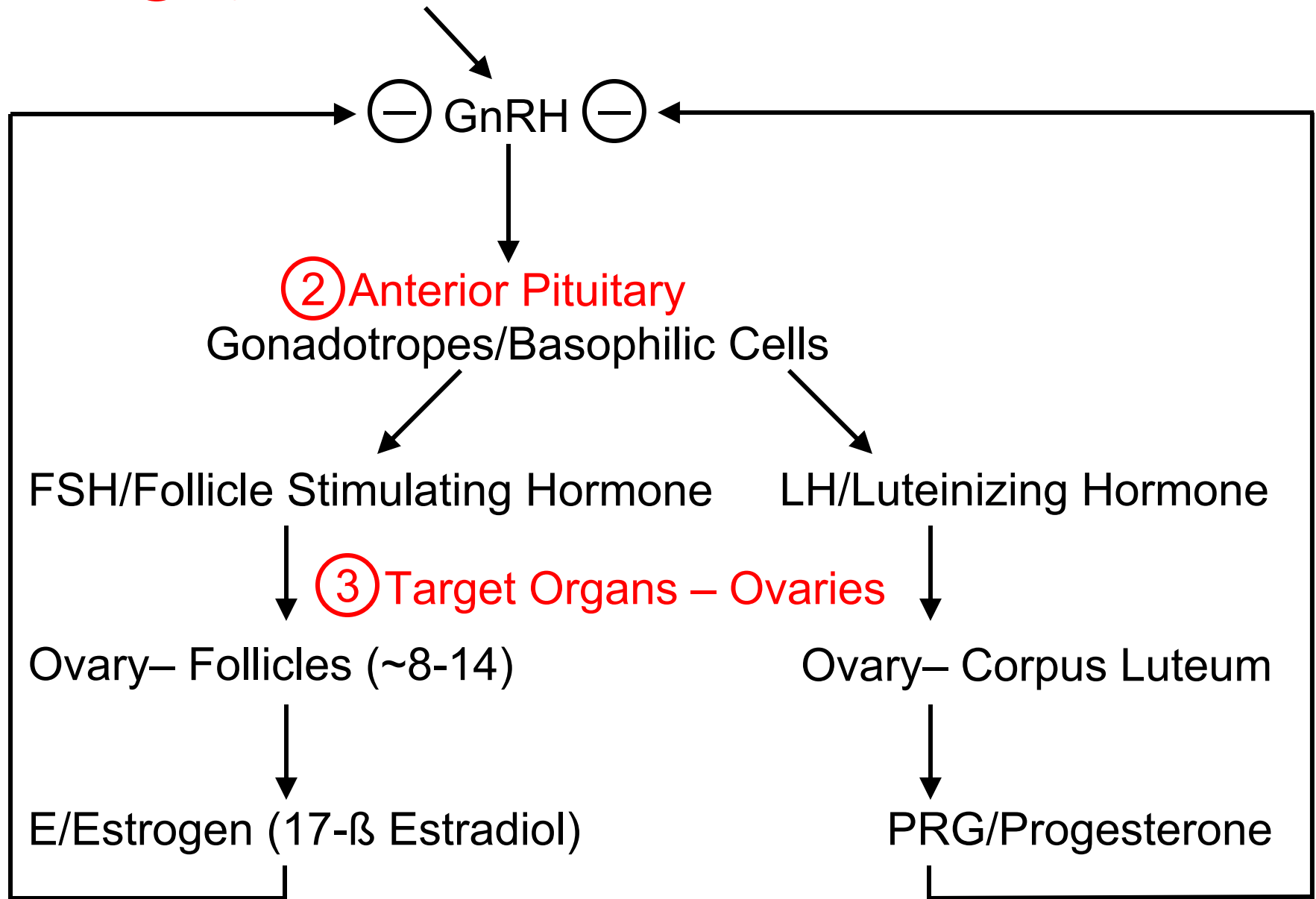
③ Target Organs – Ovaries

Ovary– Follicles (~8-14)

Ovary– Corpus Luteum

E/Estrogen (17-β Estradiol)

PRG/Progesterone



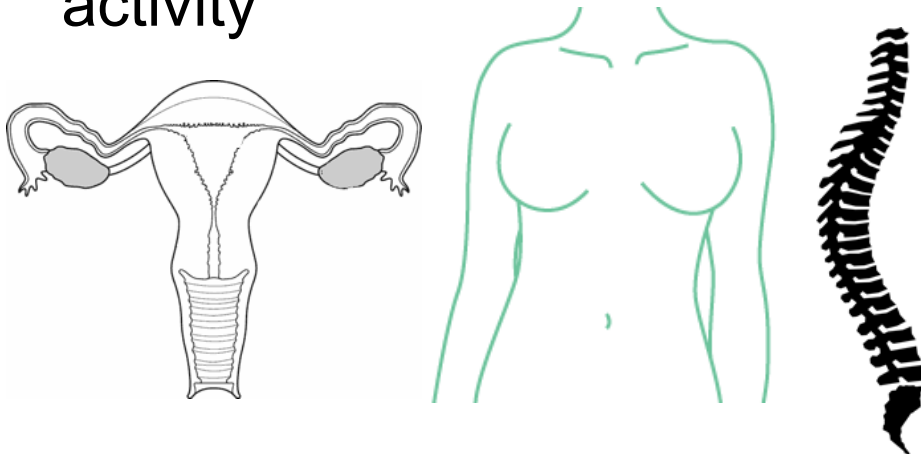


# What Do **Estrogen** & **Progesterone** Do?

## Estrogen – E

Growth & Development of:

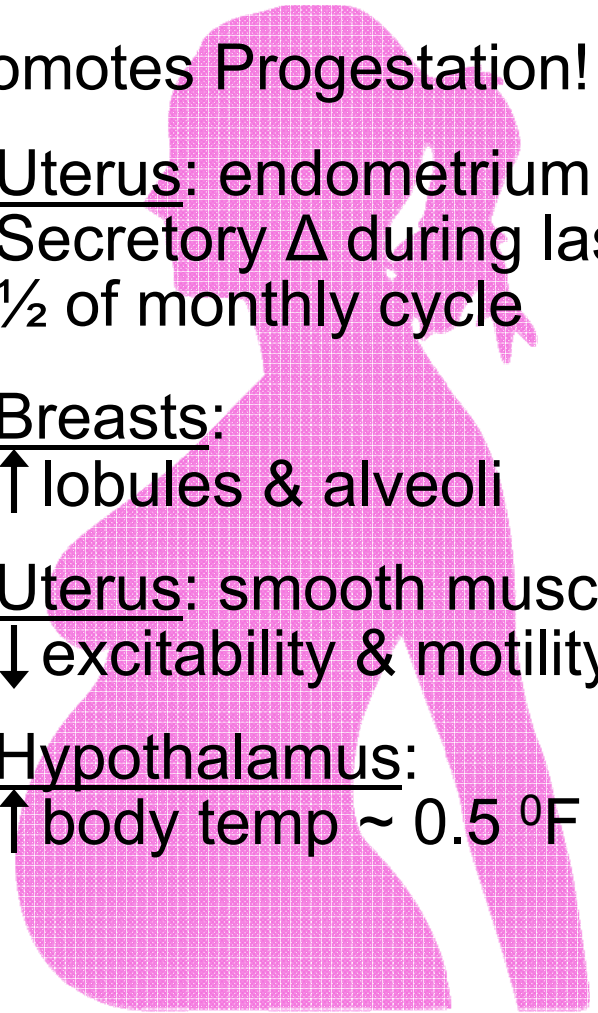
1. Ovaries, fallopian tubes, uterus, vagina, external genitalia
2. Breasts stroma, ductile systems, adipocytes
3. Skeleton → osteoblastic activity



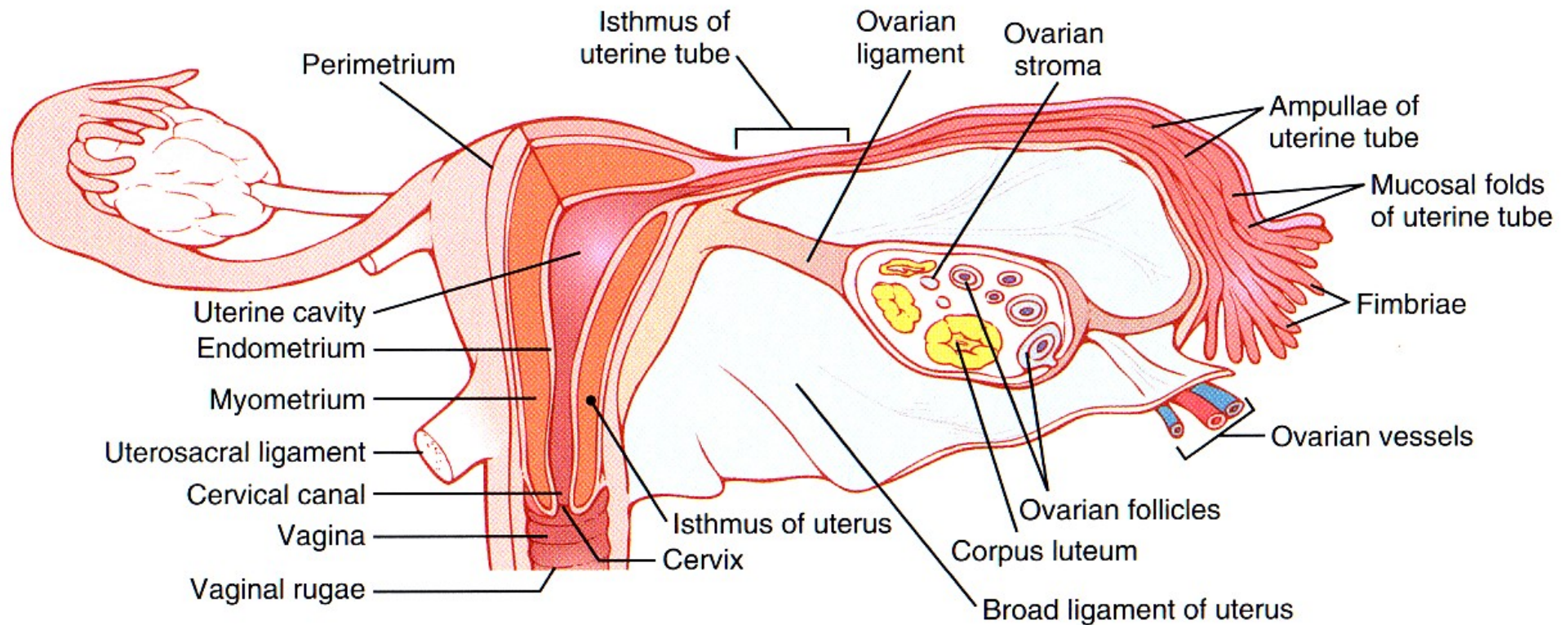
## Progesterone – PRG

Promotes Progestation!

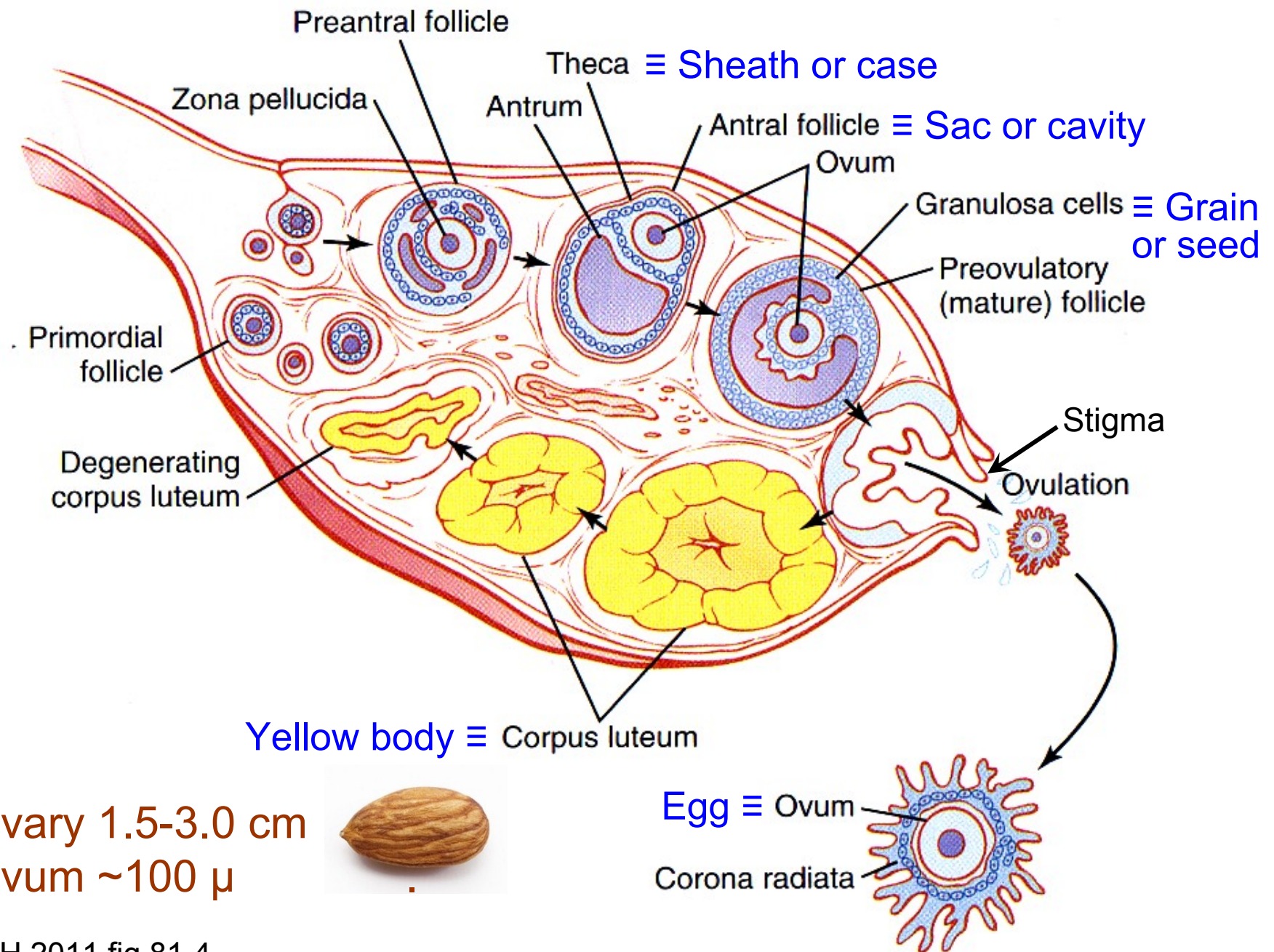
1. Uterus: endometrium  
Secretory  $\Delta$  during last  $\frac{1}{2}$  of monthly cycle
2. Breasts:  
↑ lobules & alveoli
3. Uterus: smooth muscle  
↓ excitability & motility
4. Hypothalamus:  
↑ body temp  $\sim 0.5^{\circ}\text{F}$



# *Uterus, Ovary & Uterine/Fallopian Tube*











Follicle undergoing atresia

This histological image shows a cross-section of an ovary. The outer layer is the tunica albuginea, followed by the tunica vaginalis. The internal region is the cortex, containing numerous follicles at different stages of development. A large, pale-staining follicle on the left is a Graafian follicle, containing a large, clear ovum. Smaller, more numerous follicles are scattered throughout the cortex. Some follicles show signs of atresia, appearing shrunken and dark. The medulla is visible in the center, containing blood vessels and connective tissue. Labels with arrows point to specific features: 'Follicle undergoing atresia' points to a small, dark follicle; 'Primary Oocytes' points to a large area of the cortex filled with small, round follicles; 'Ovum' points to a single cell within a follicle; 'Graafian Follicle with developing ovum/egg' points to the large, pale follicle; and 'Ovary cross section' is a general label for the entire image.

Primary Oocytes

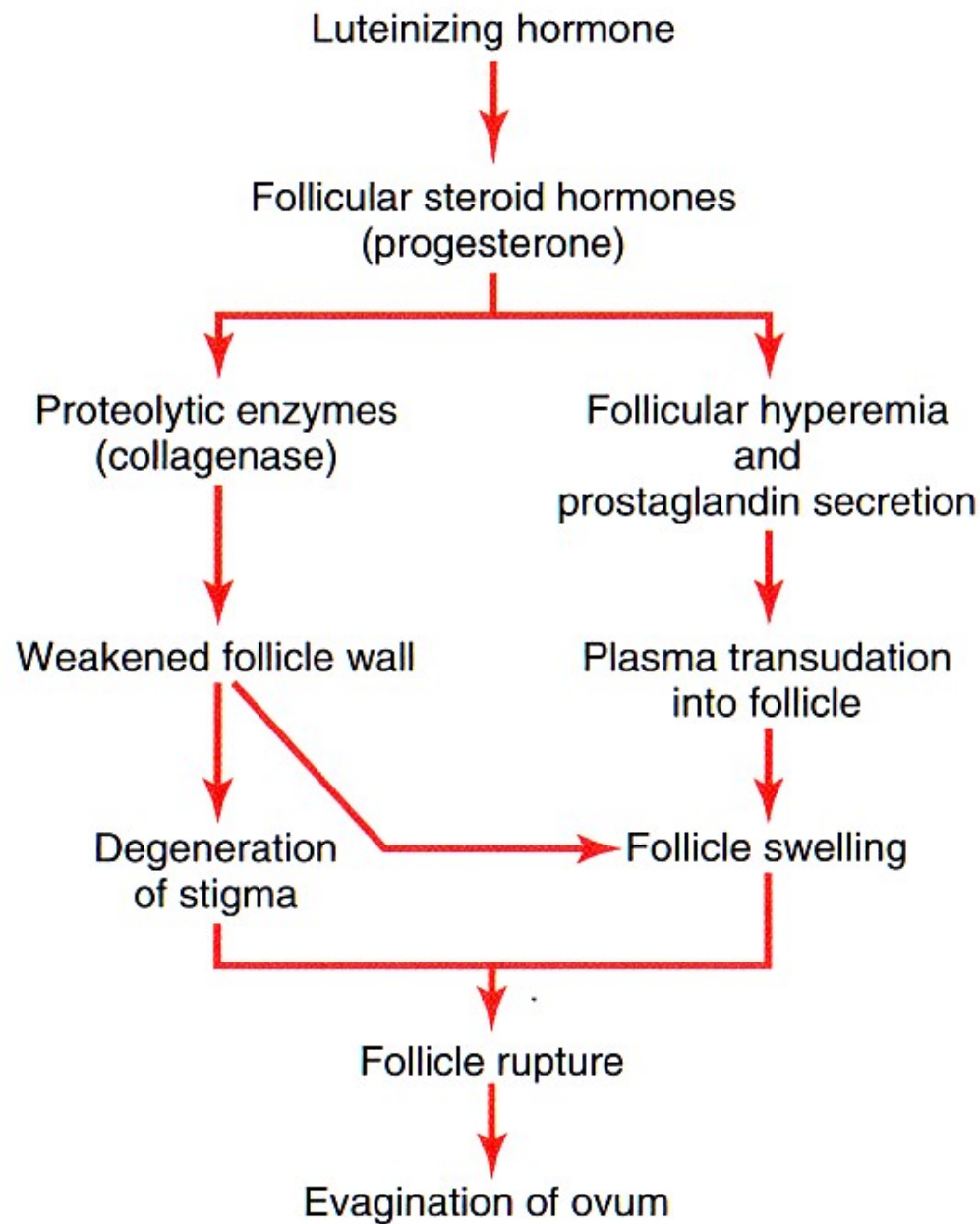
Ovum

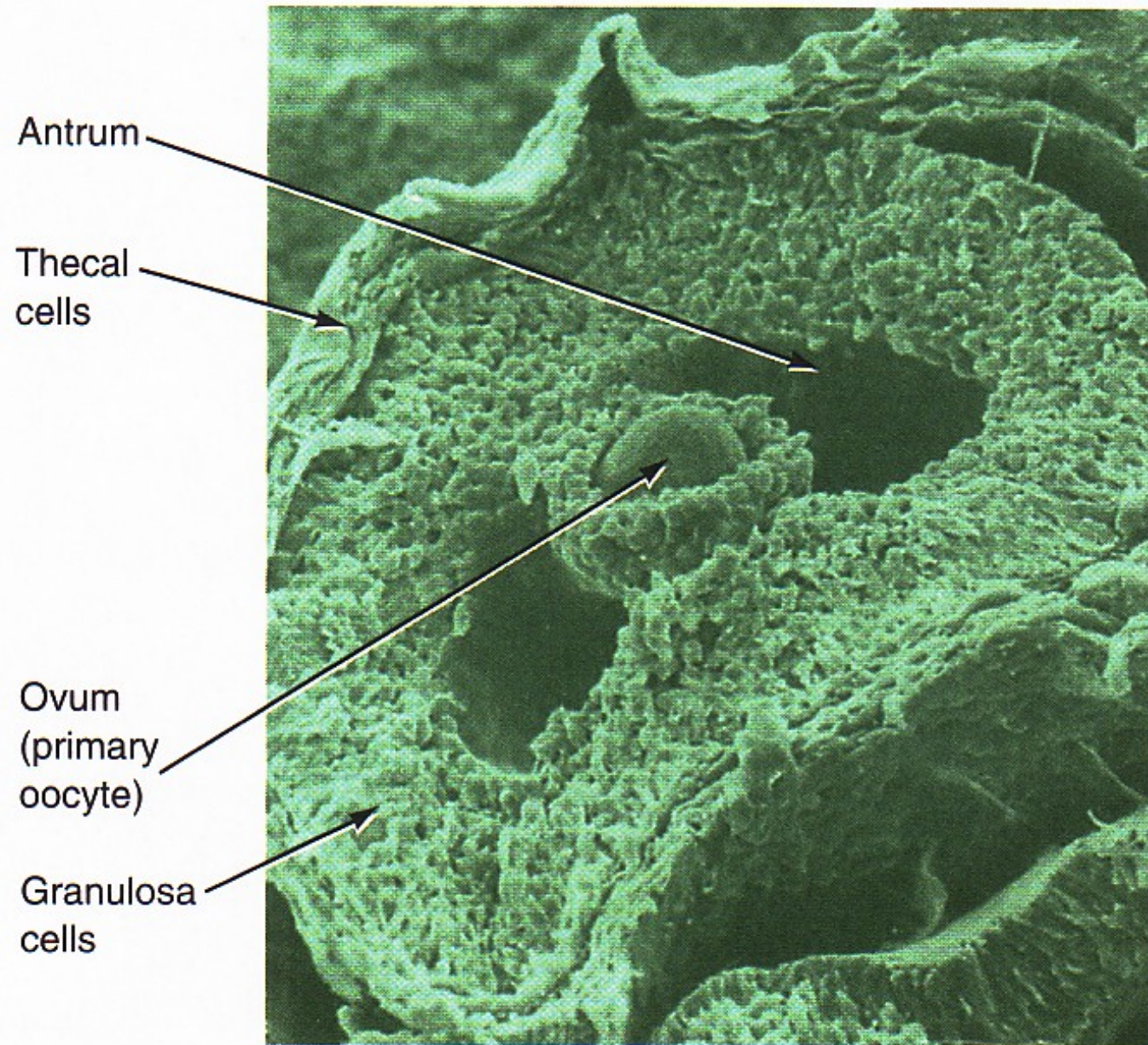
Graafian Follicle with  
developing ovum/egg

Ovary cross section



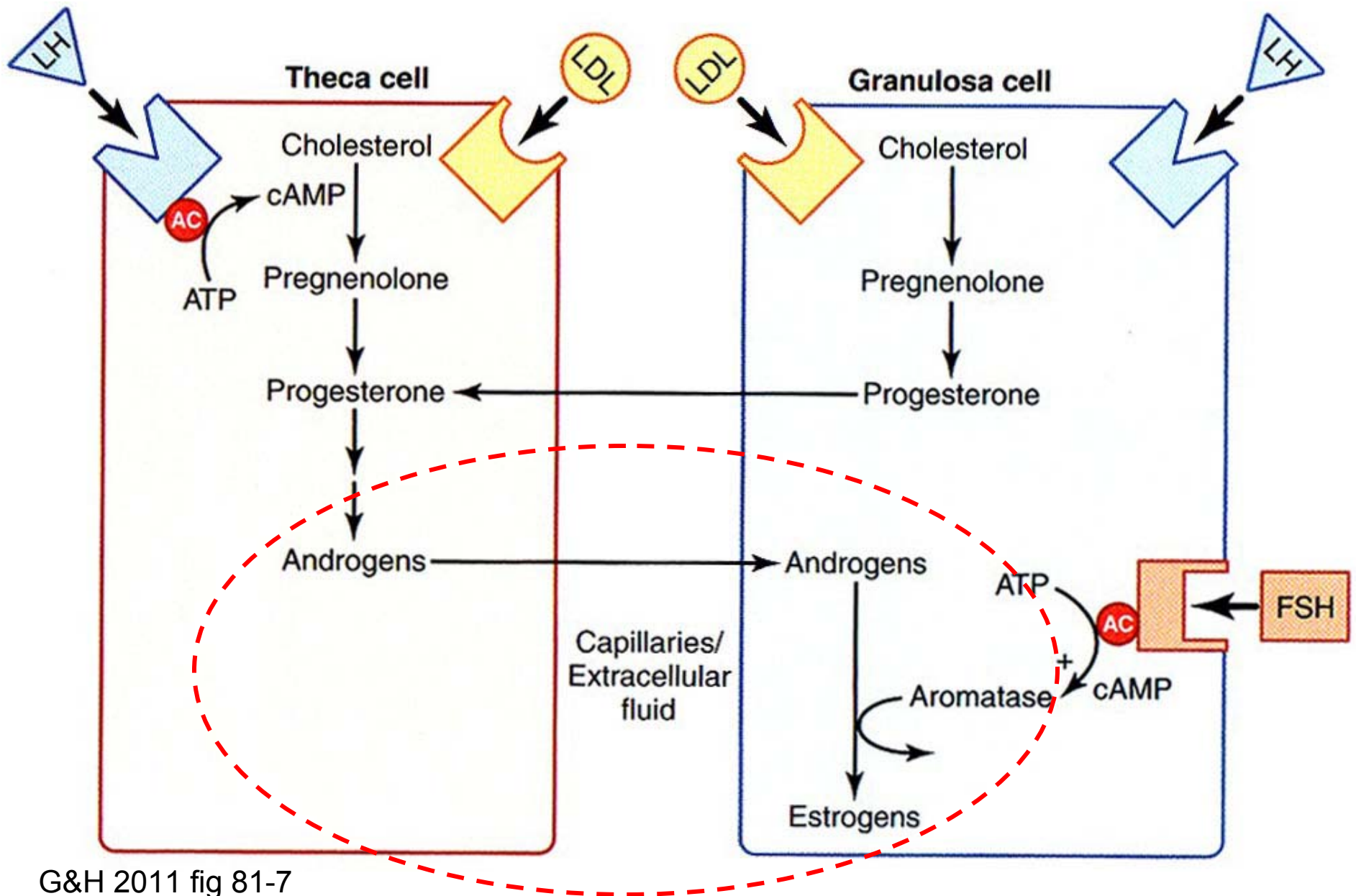
# *Proposed Ovulation Mechanism*

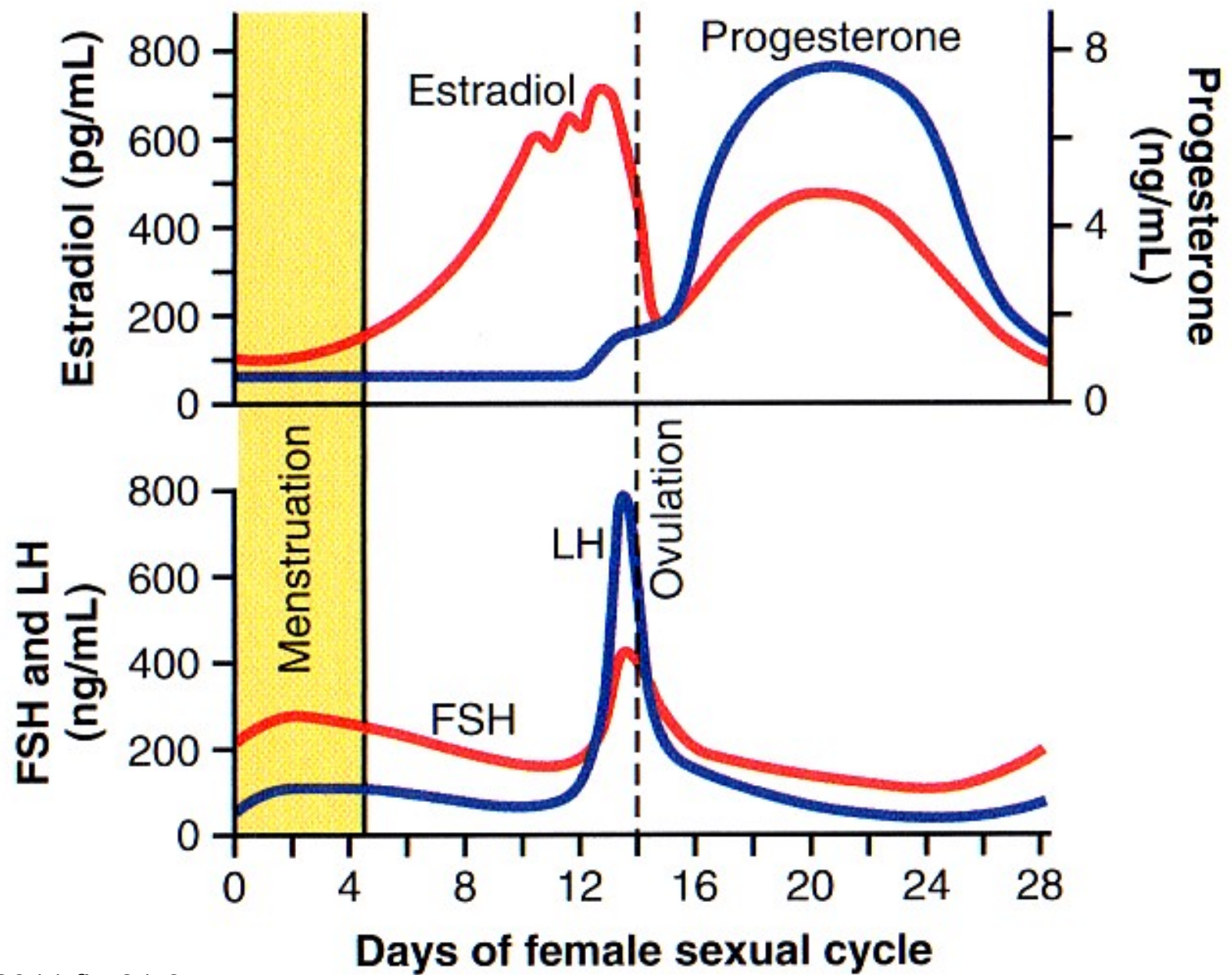




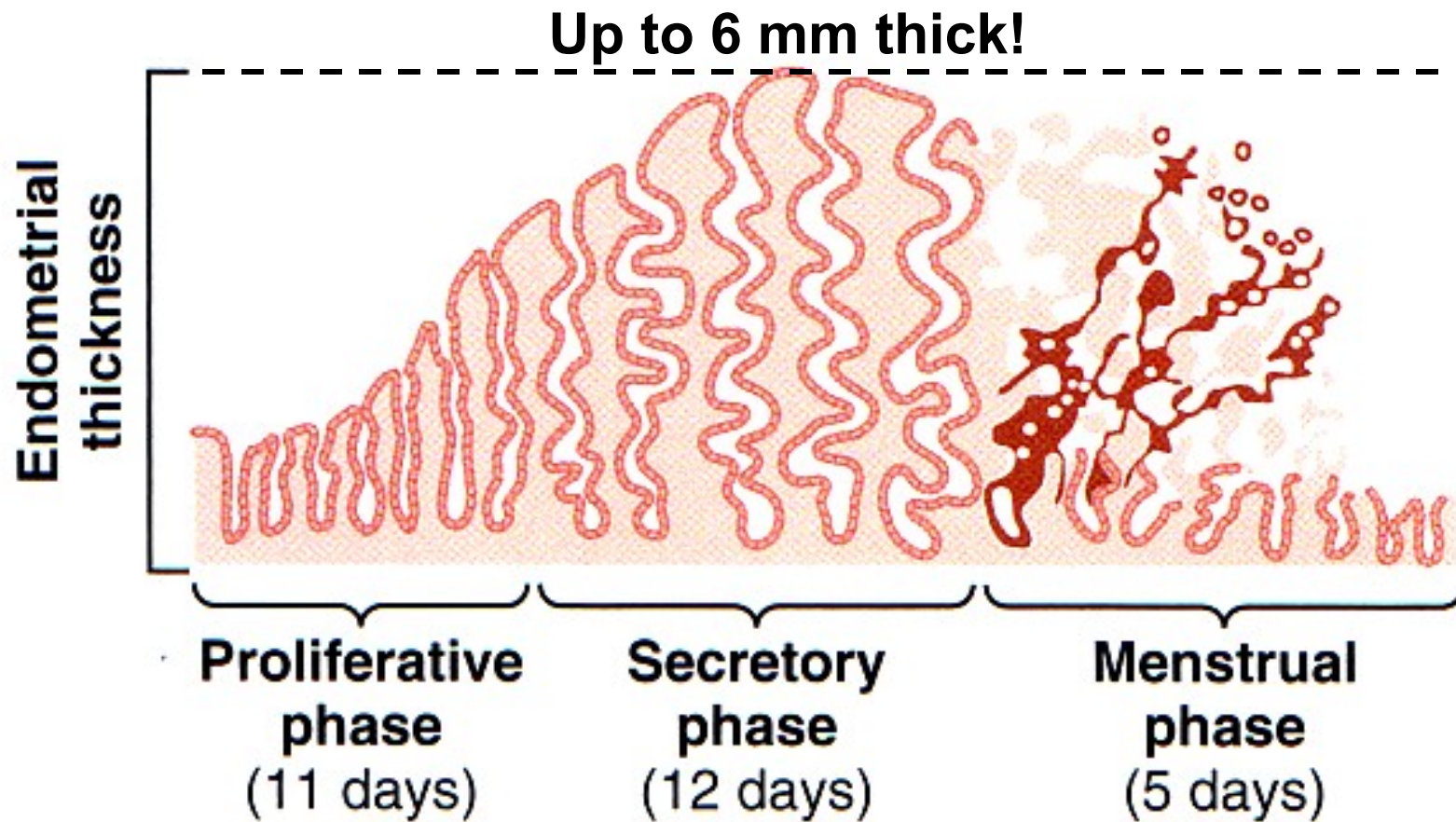


## Estrogen Production: Theca & Granulosa Cell Interaction

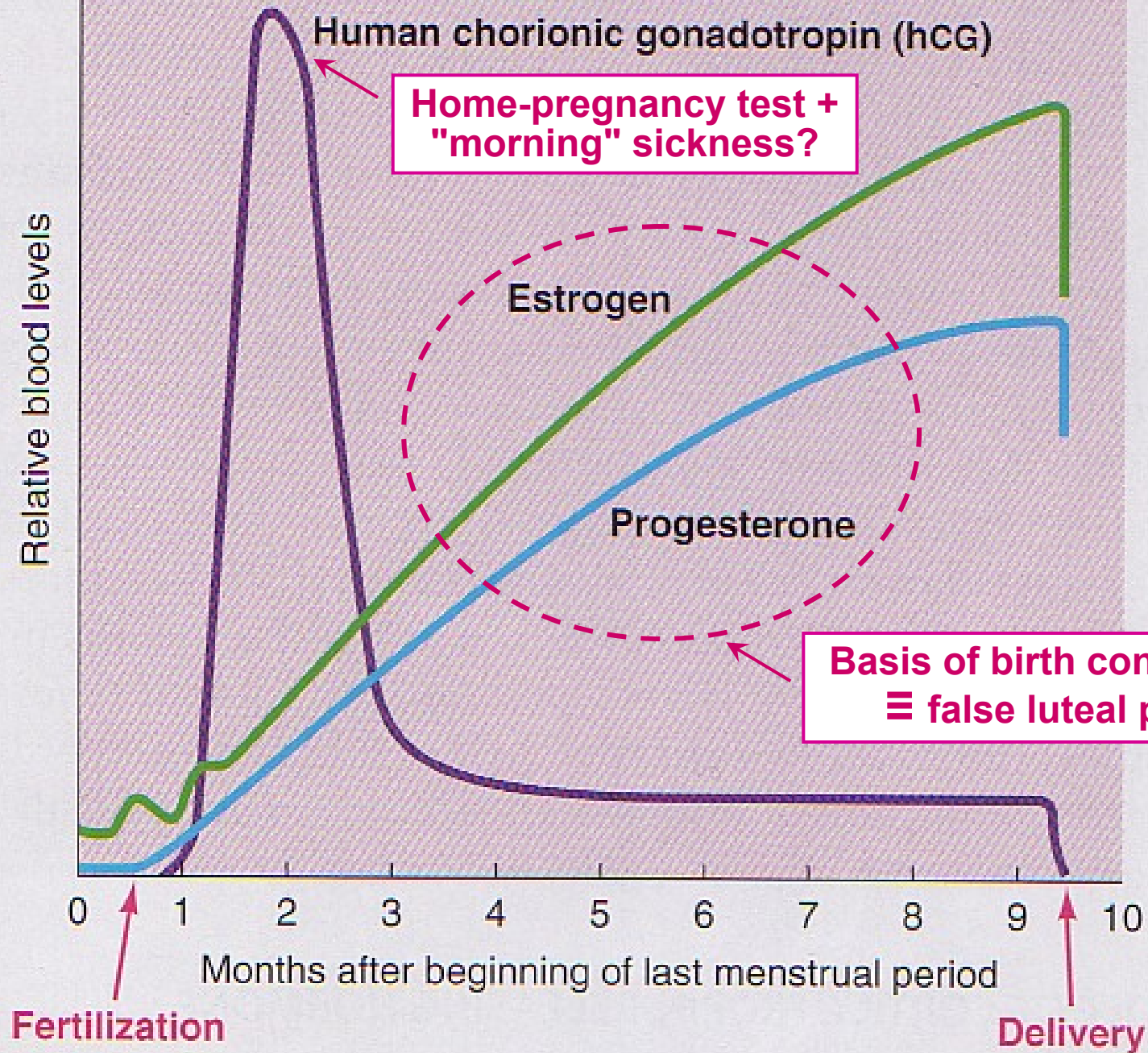




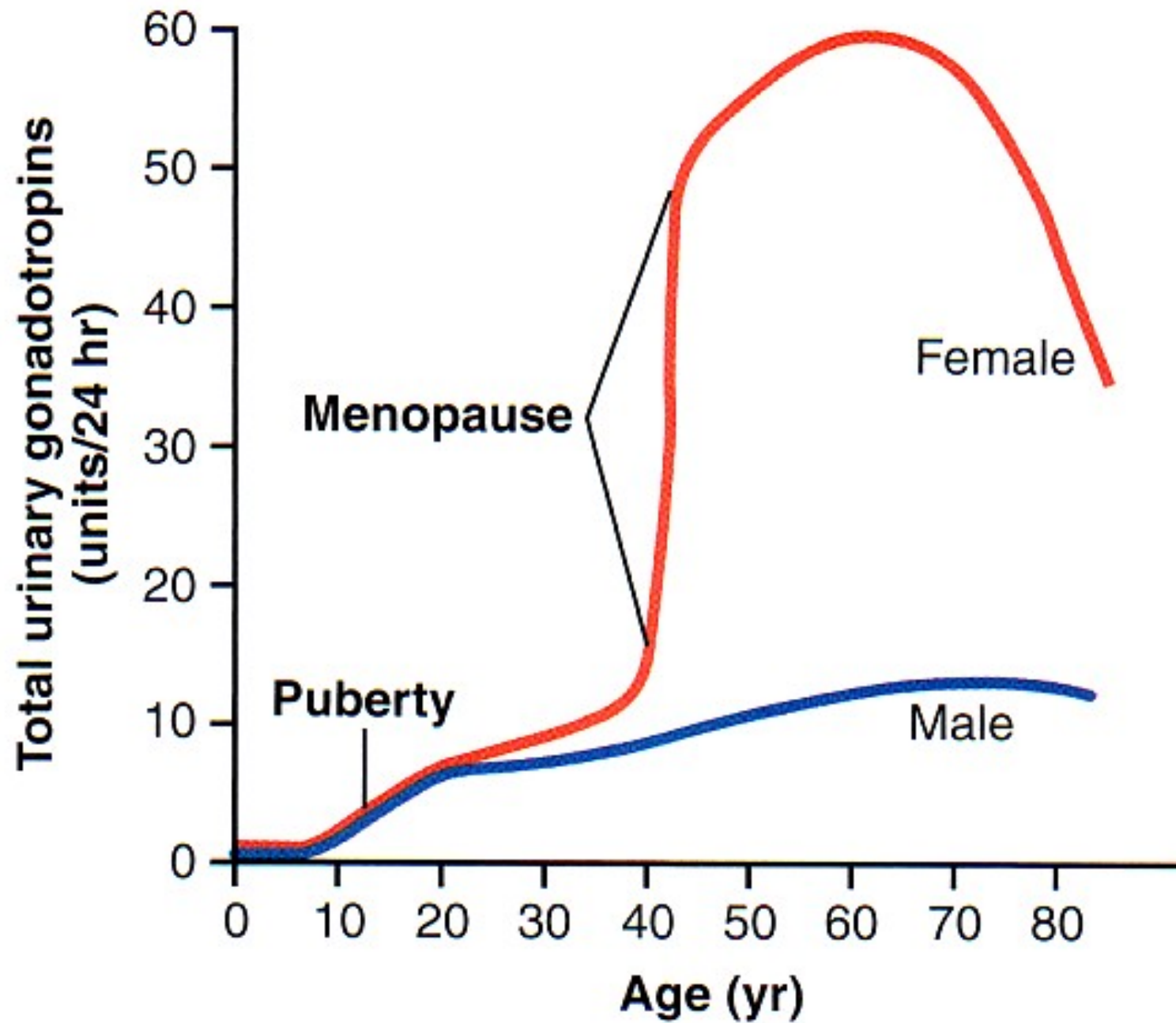




**Figure 81-8** Phases of endometrial growth and menstruation during each monthly female sexual cycle.

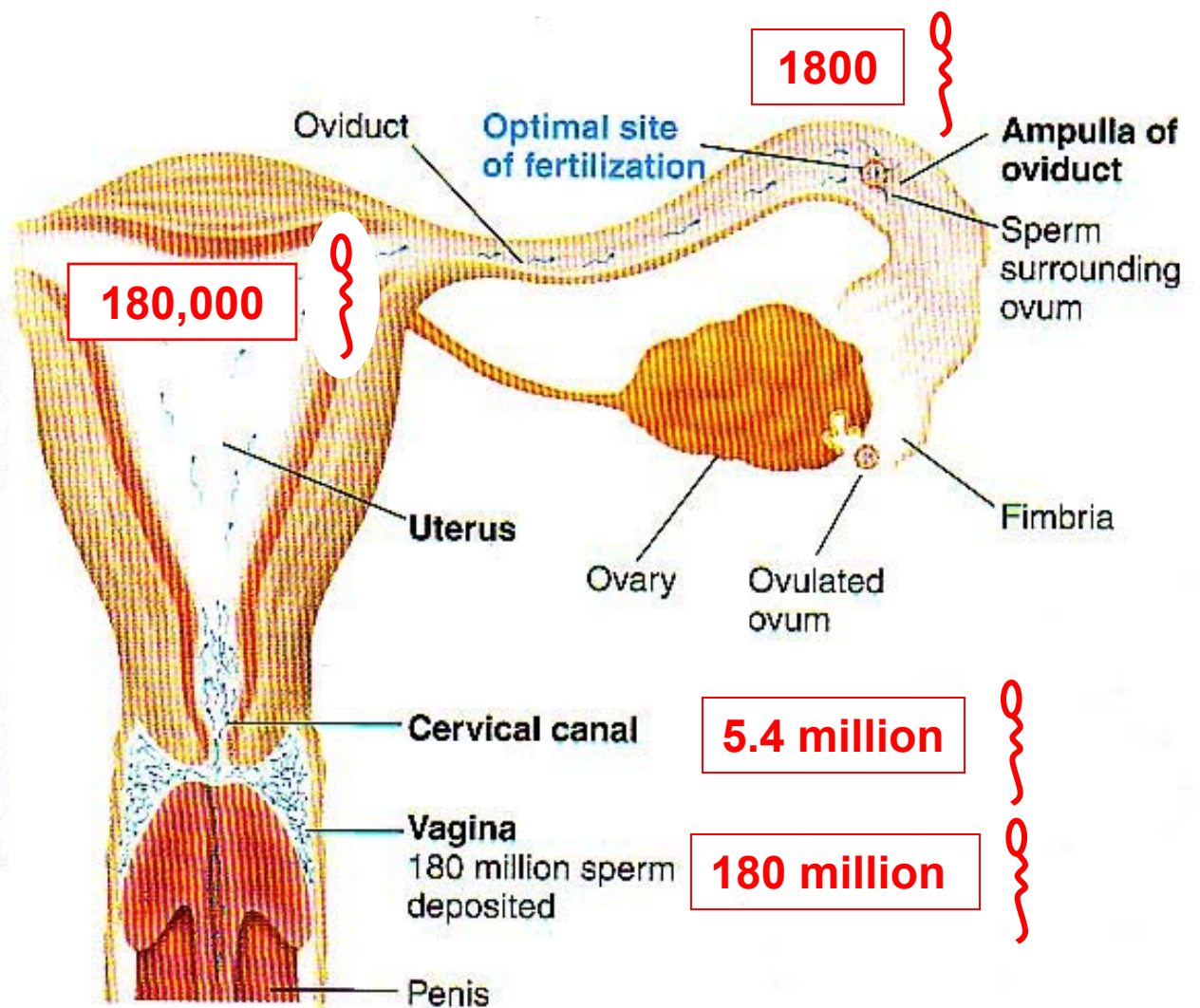






Location	Time of appearance (min after ejaculation)	Percent of ejaculated sperm*
<b>Fertilization site</b> (upper third of oviduct)	30–60	0.001
<b>Uterus</b>	10–20	0.1
<b>Cervical canal</b>	1–3	3
<b>Vagina</b>	0	100

\*Based on data from animals.  
Sperm and ovum enlarged.



● FIGURE 20-20

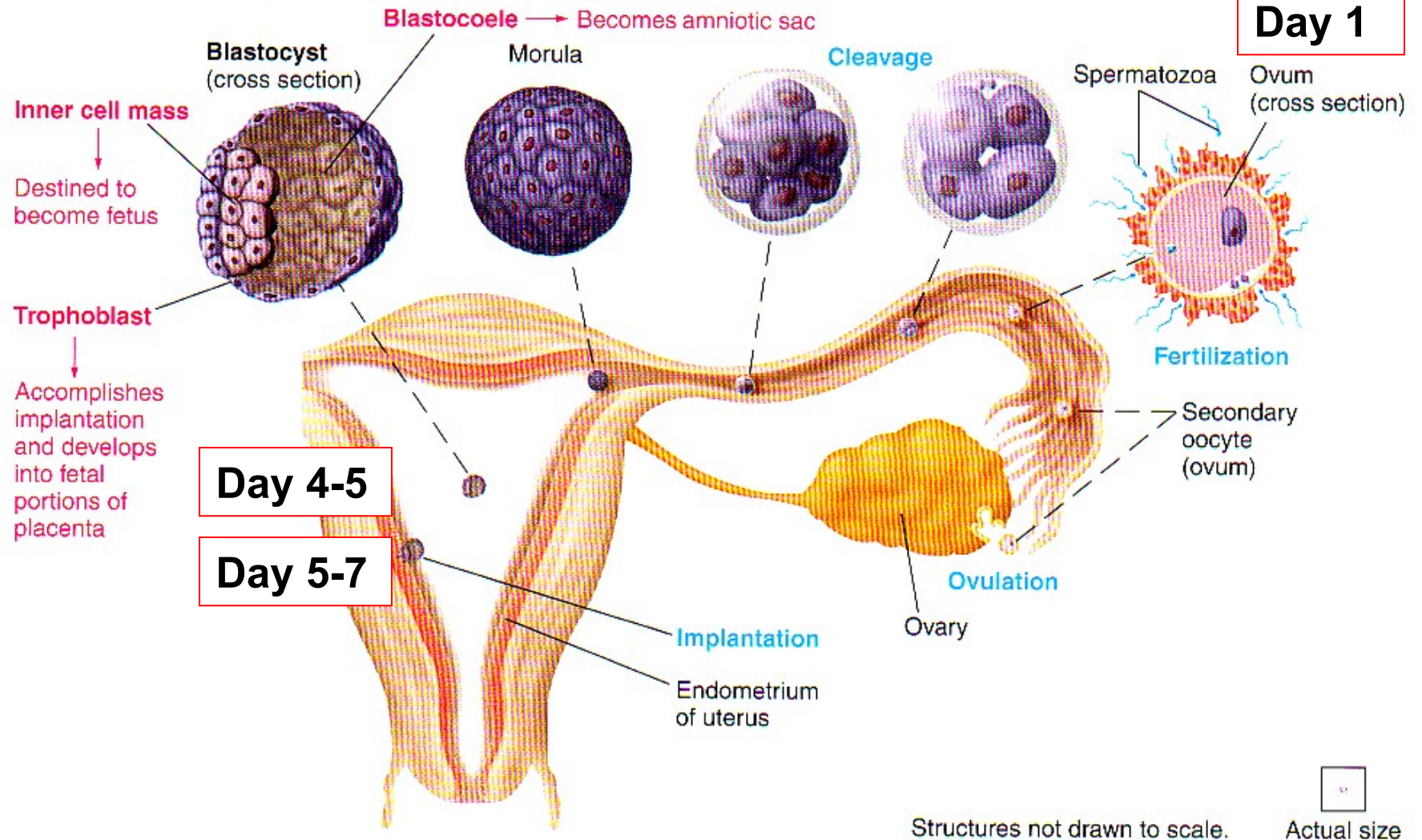
Ovum and sperm transport to the site of fertilization



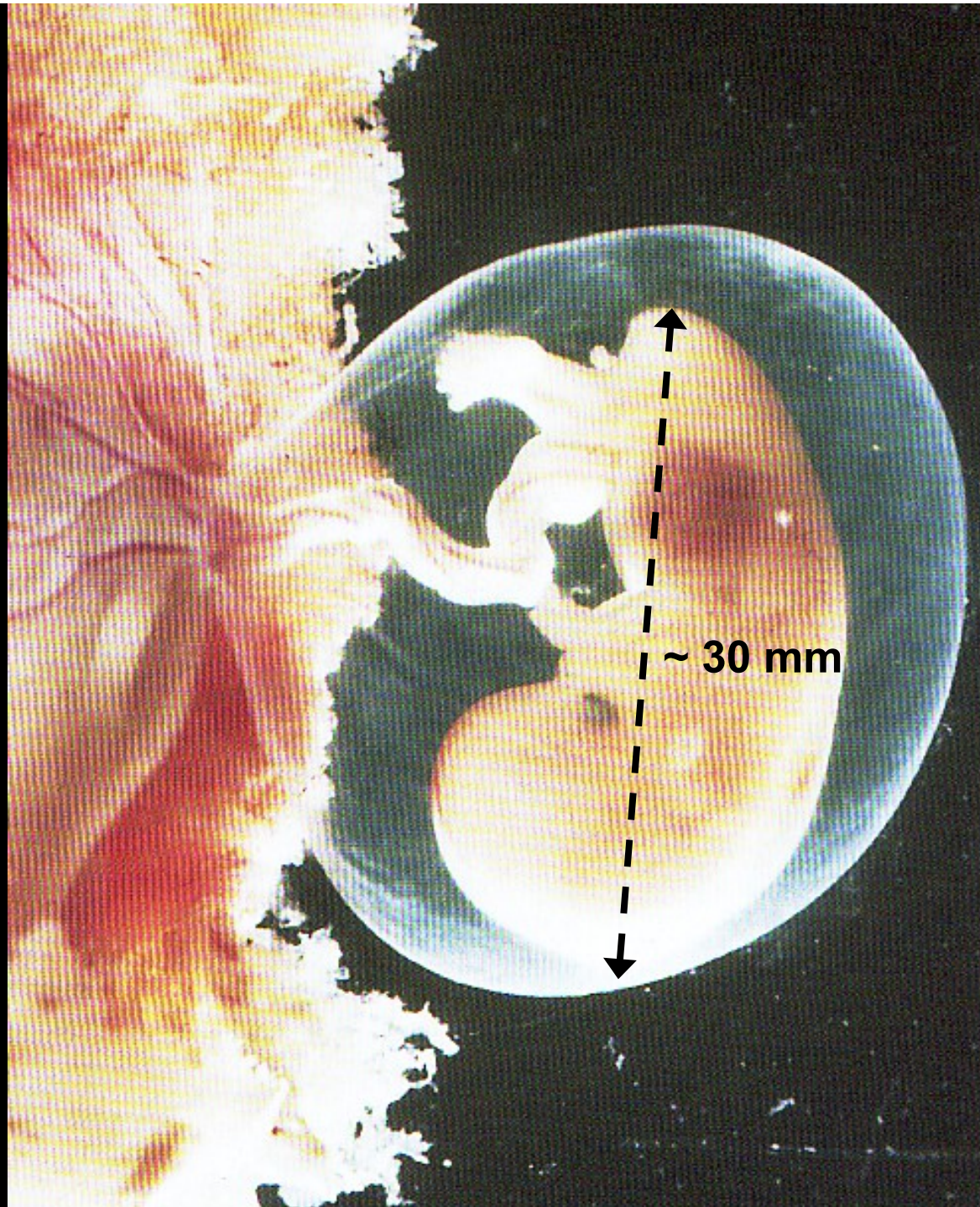
● **FIGURE 20-23**

**Early stages of development from fertilization to implantation**

Note that the fertilized ovum progressively divides and differentiates into a blastocyst as it moves from the site of fertilization in the upper oviduct to the site of implantation in the uterus.



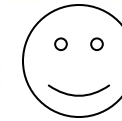









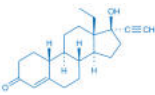

**~ 56 days**



Abstinence  
works best!



## Average Failure Rate of Various Contraceptive Techniques

Contraceptive Method	Average Failure Rate (annual pregnancies/ 100 women)
None 	90
Natural (rhythm) methods 	20–30
Coitus interruptus 	23
Chemical contraceptives	20
Barrier methods 	10–15
Oral contraceptives 	2–2.5
Implanted contraceptives 	1
Intrauterine device 	4



# *Important Facts*



- 6.4 Million pregnancies,  $\frac{1}{2}$  unwanted in US/yr
- 1.6 Million end in abortion
- Sperm survive for 48 hr to 5 d in female reproductive tract
- Eggs start to disintegrate 12-24 hr > ovulation
- Ovulation varies & may be tough to predict...

<http://www.cdc.gov/nchs/fastats/births.htm>

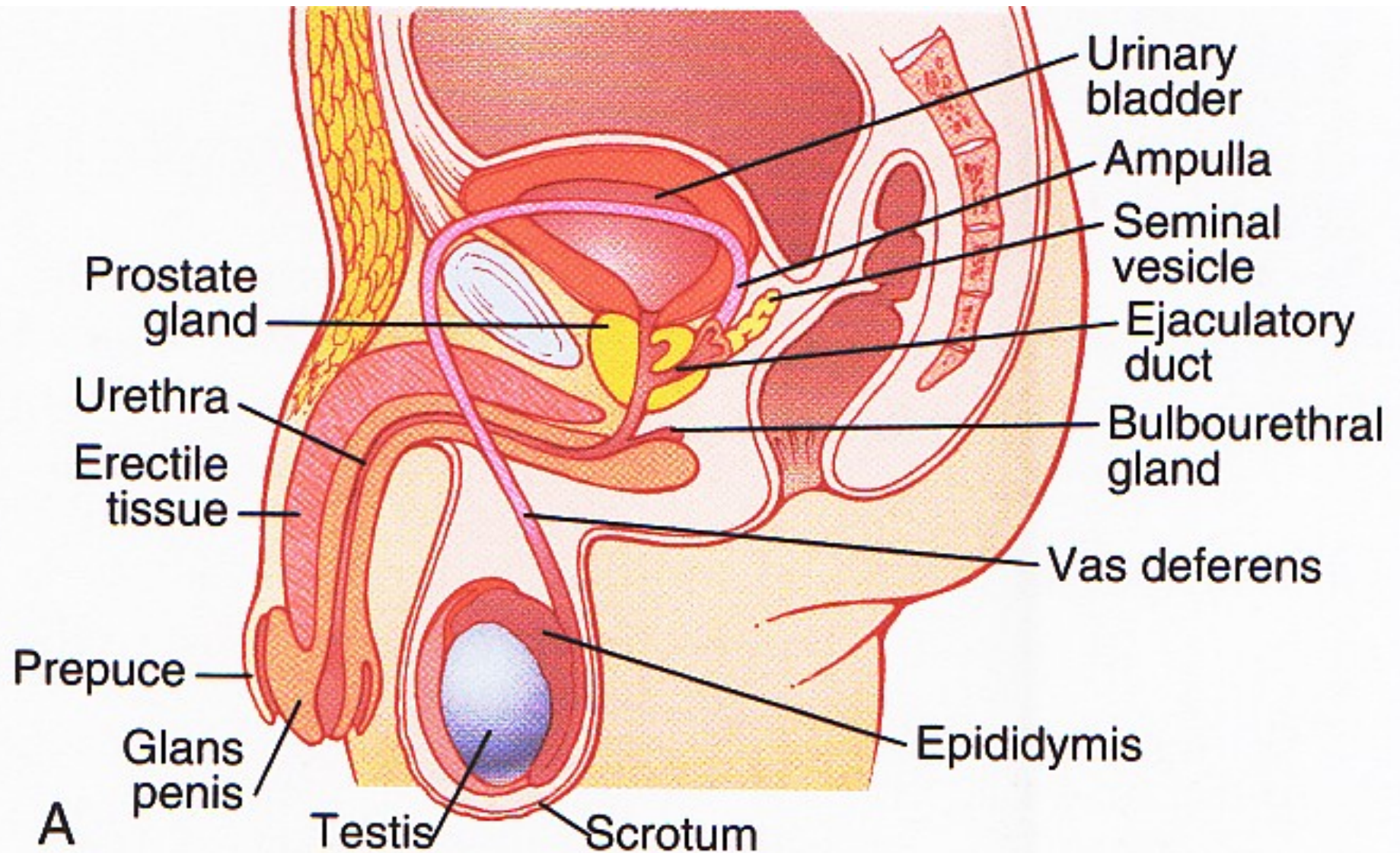
<http://www.who.int/reproductivehealth/en/>

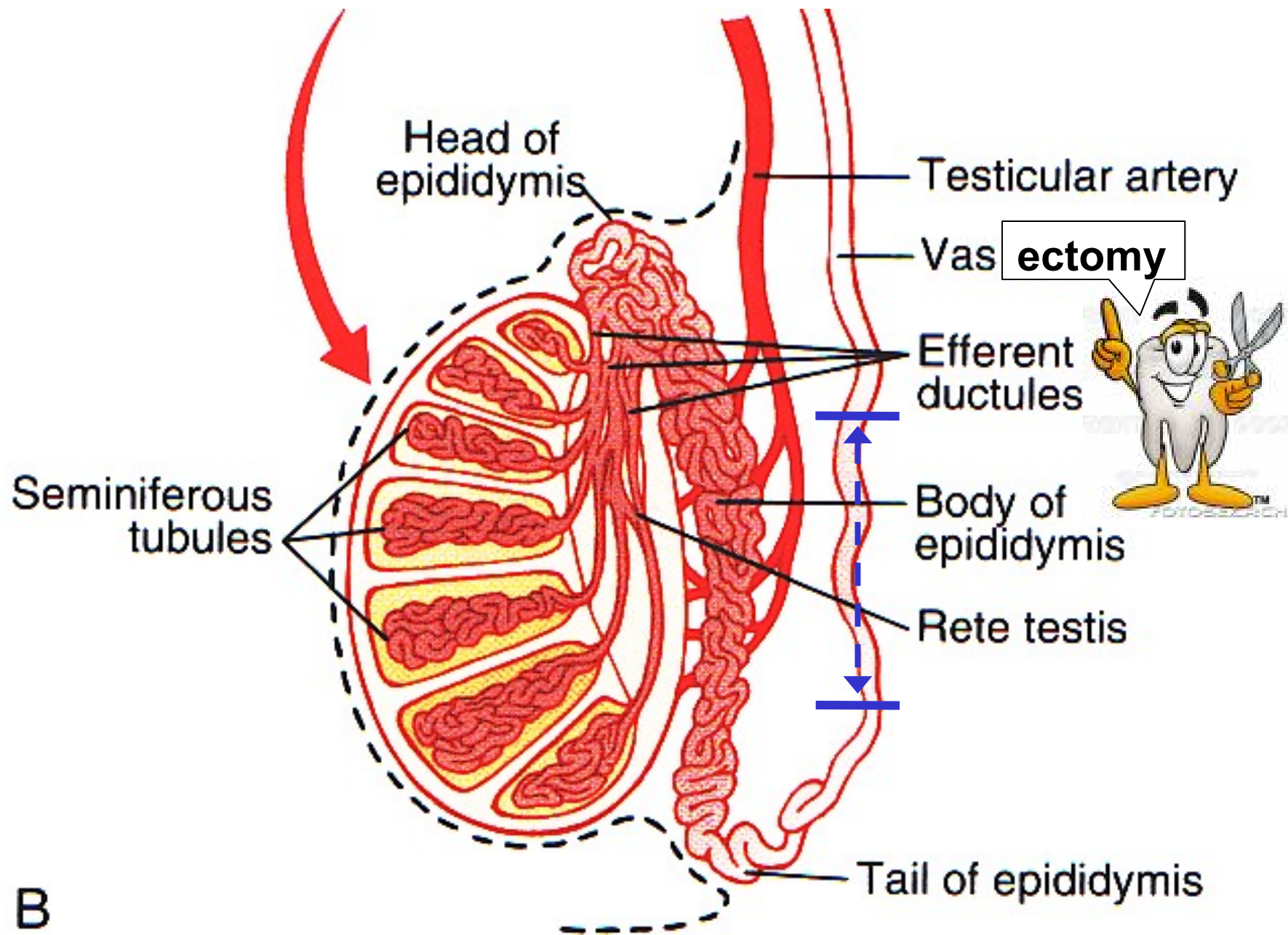
<http://www.kinseyinstitute.org/research/index.html>

<http://www.kinseyinstitute.org/resources/FAQ.html>

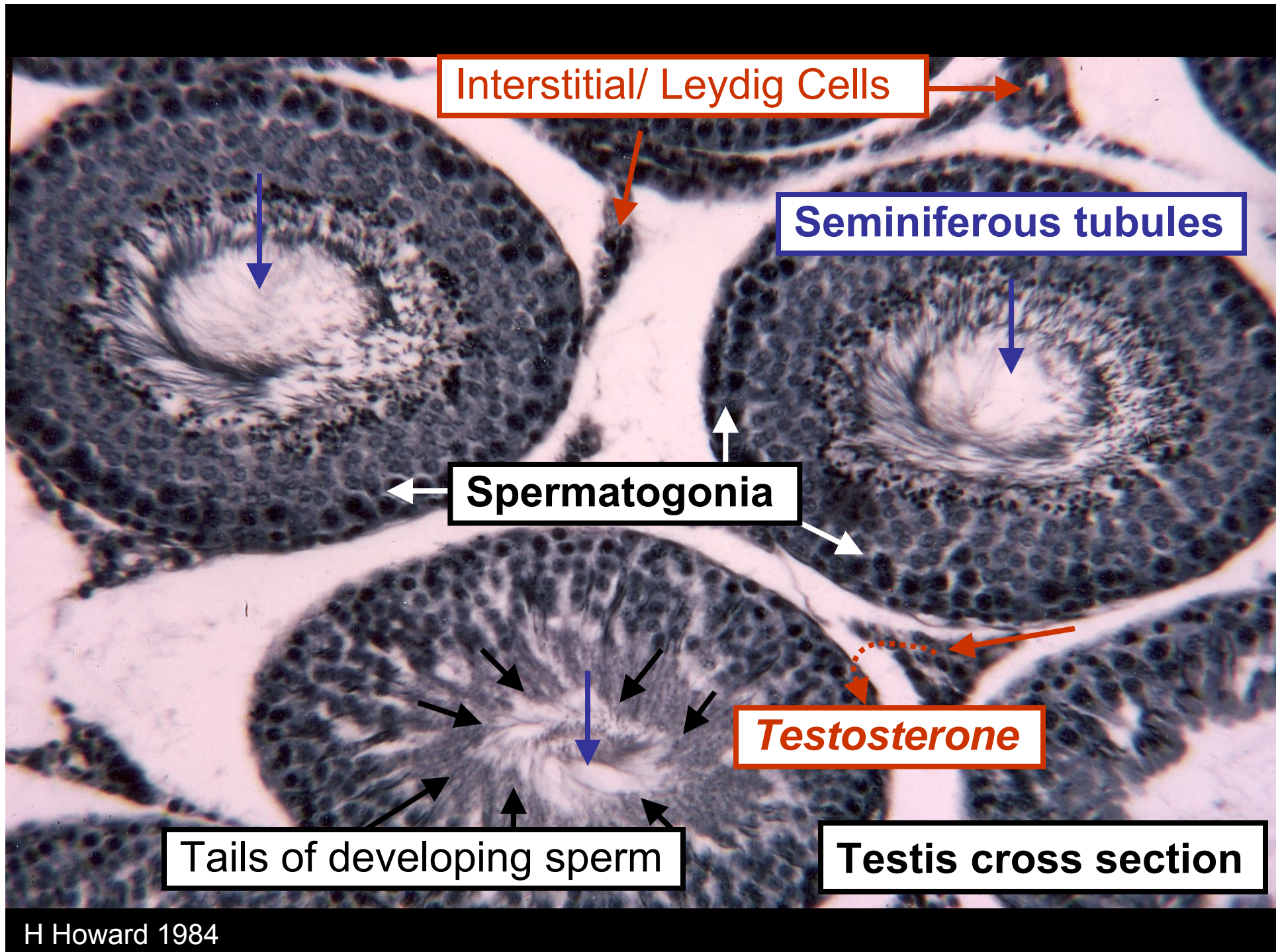


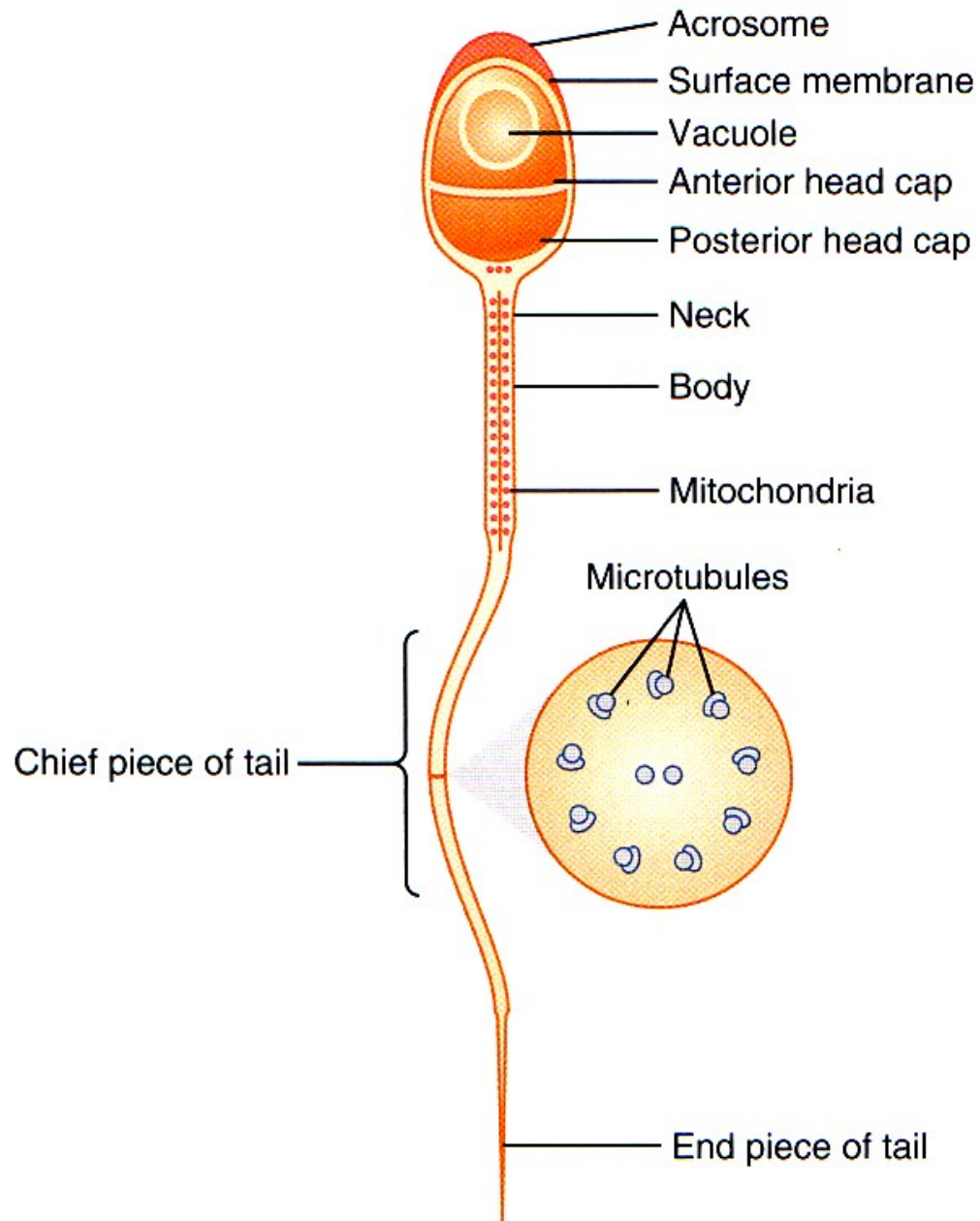
# *Male Reproductive System*







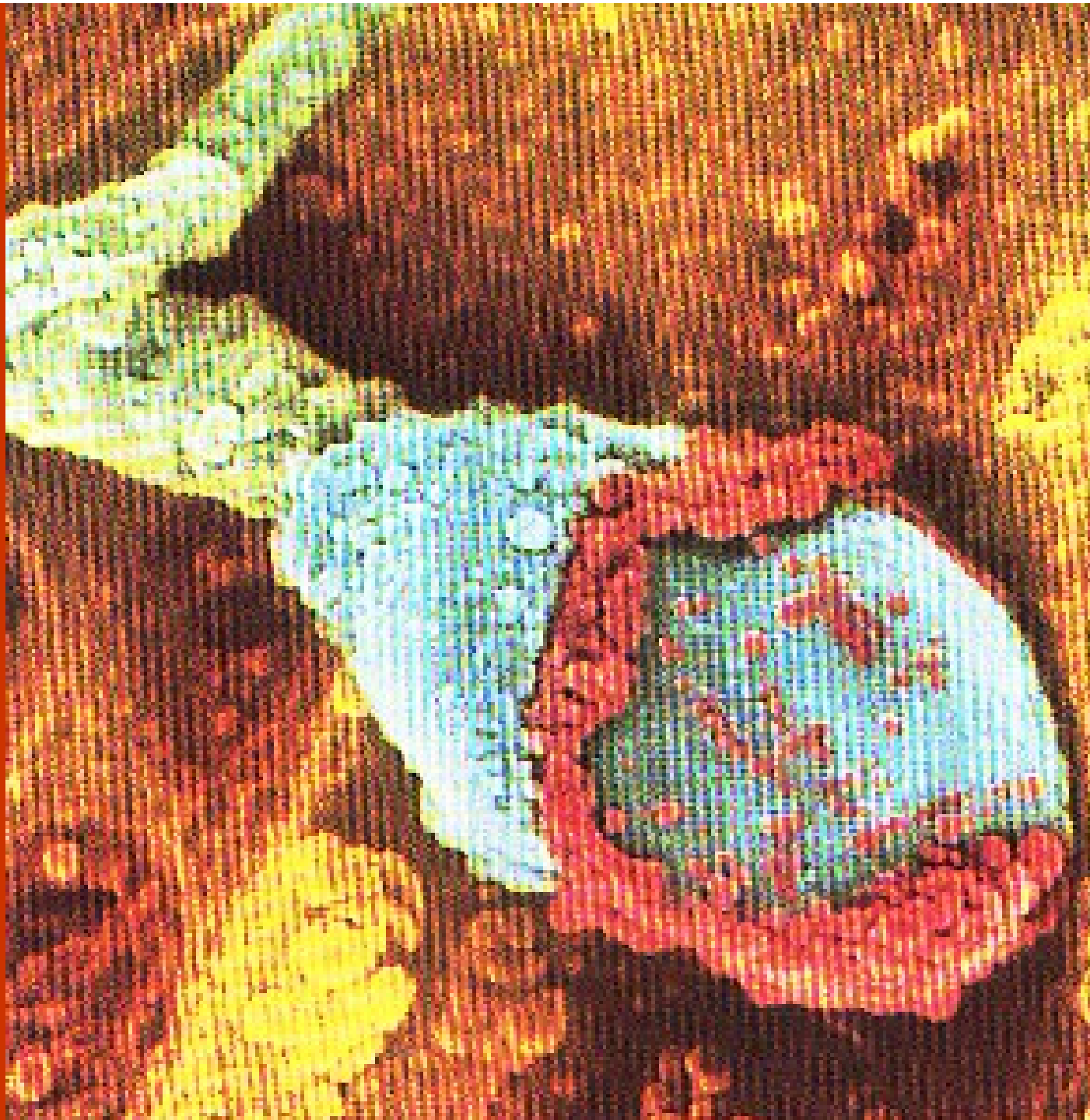




**Figure 80-4** Structure of the human spermatozoon.







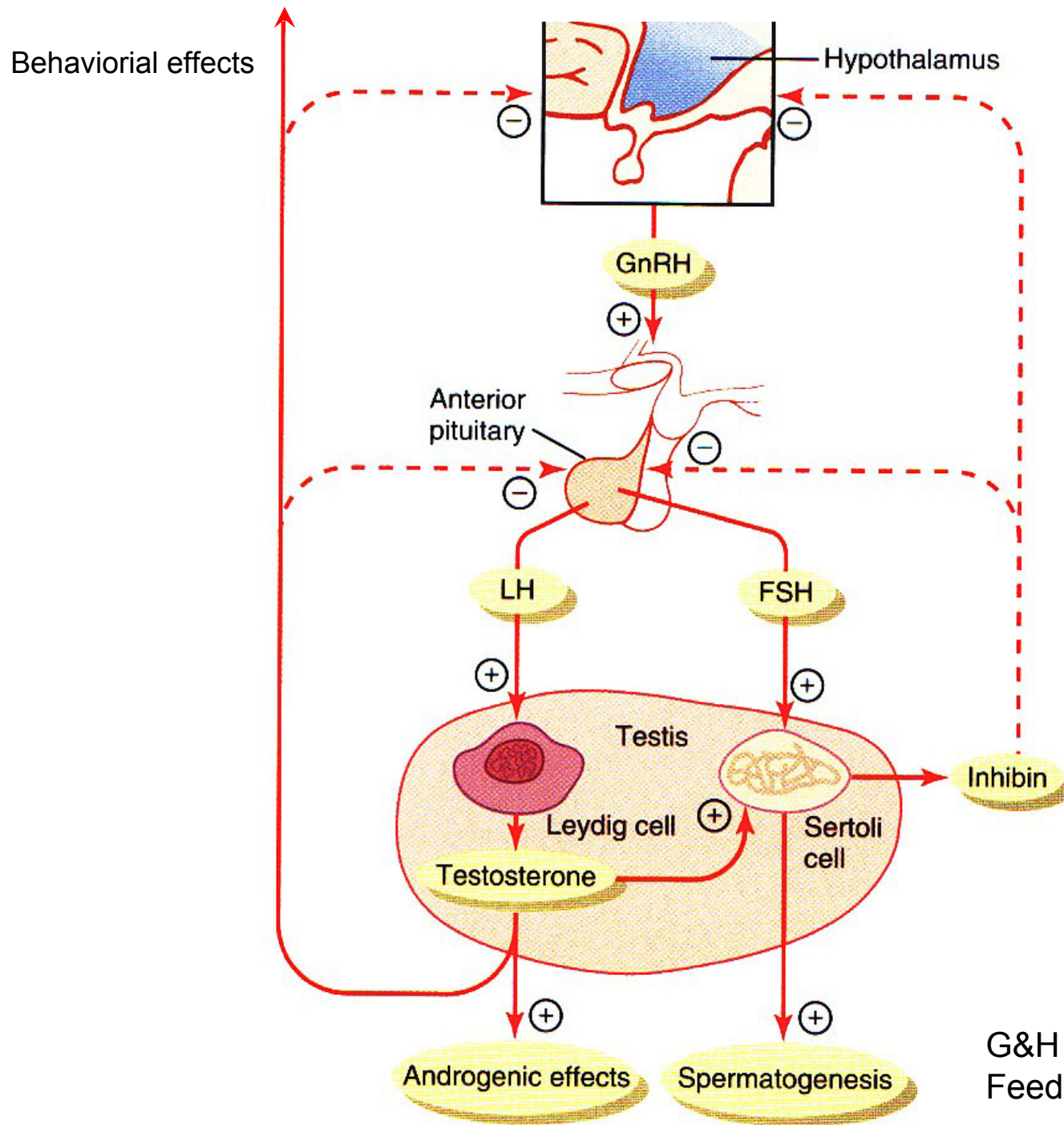
LS1 2007





**Figure 80-5** Abnormal infertile sperm, compared with a normal sperm on the right.

G&H 2011



G&H 2011 fig 80-10  
Feedback regulation in males



