OPTI ACADEMY · HORMONE BASICS

Female & Male Hormones

The female cycle and menopause, the male hormone cycle and andropause: two systems, one axis.

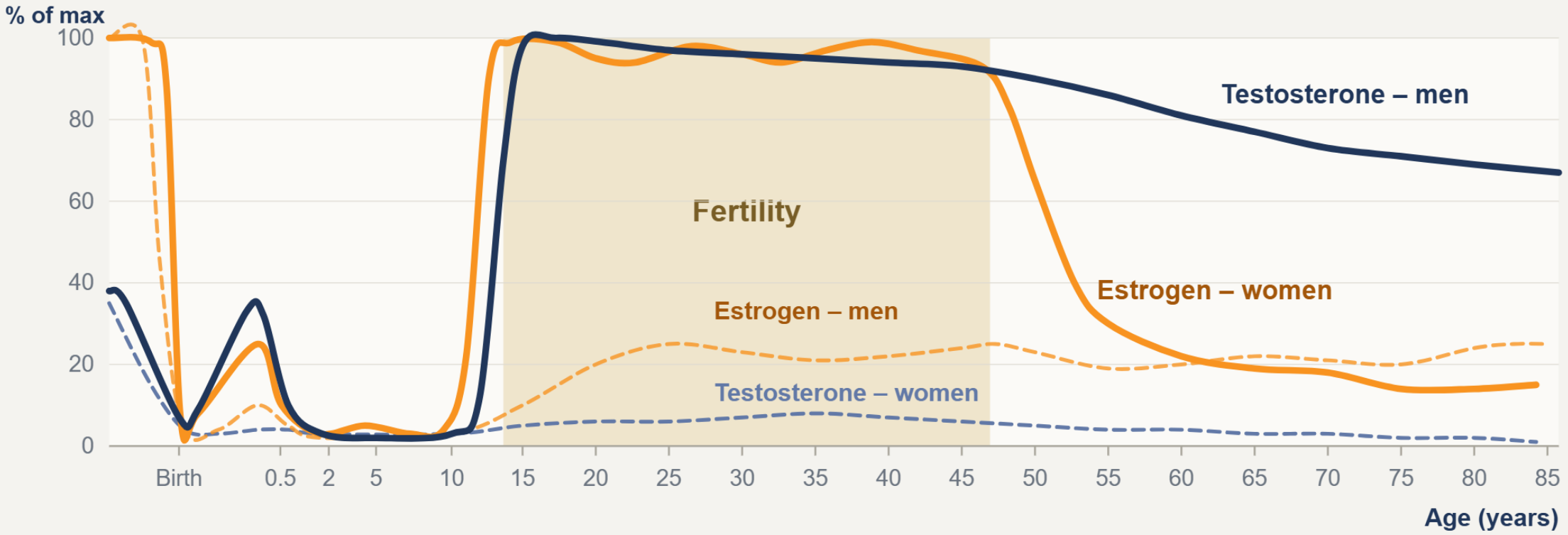
OPTI ACADEMY · HORMONE BASICS

The Female Cycle & Menopause

How the monthly cycle works, and how it comes to an end: egg development, ovulation, the uterine lining, and the transition into menopause.

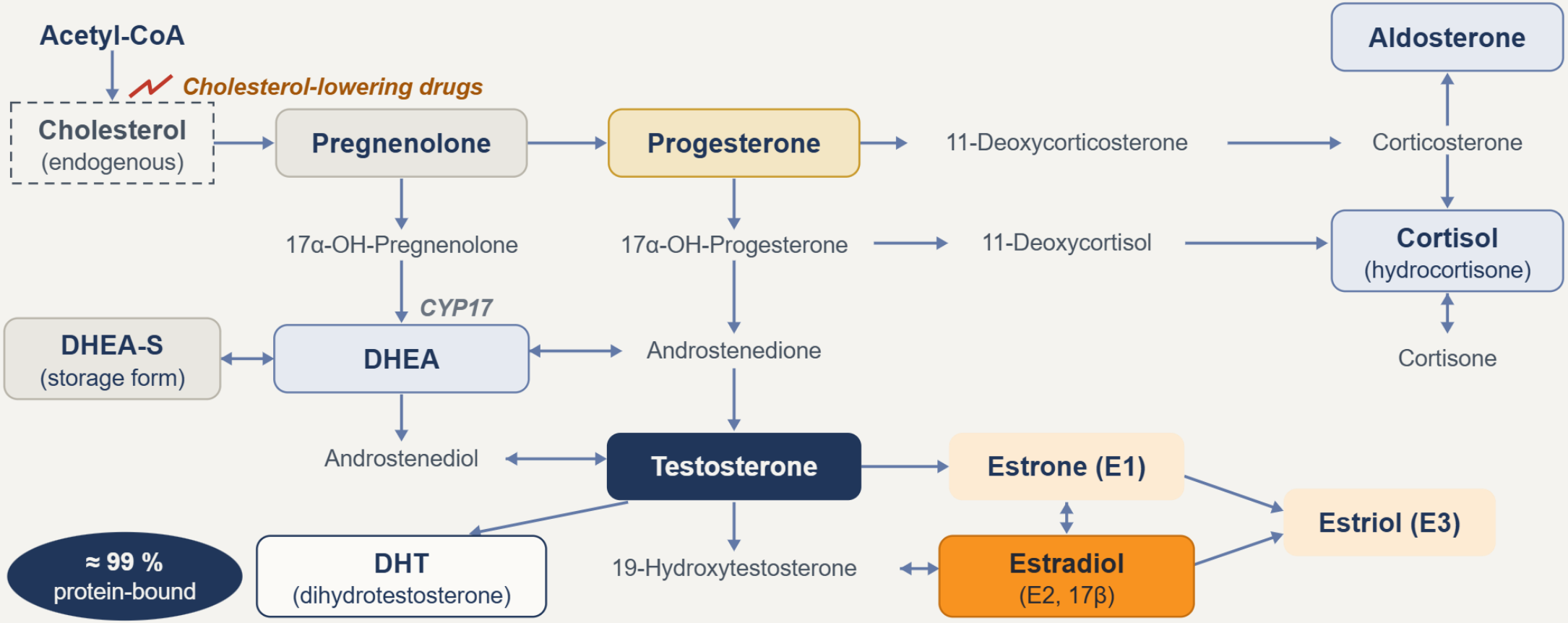
THE BIG PICTURE

Estrogen and testosterone across life



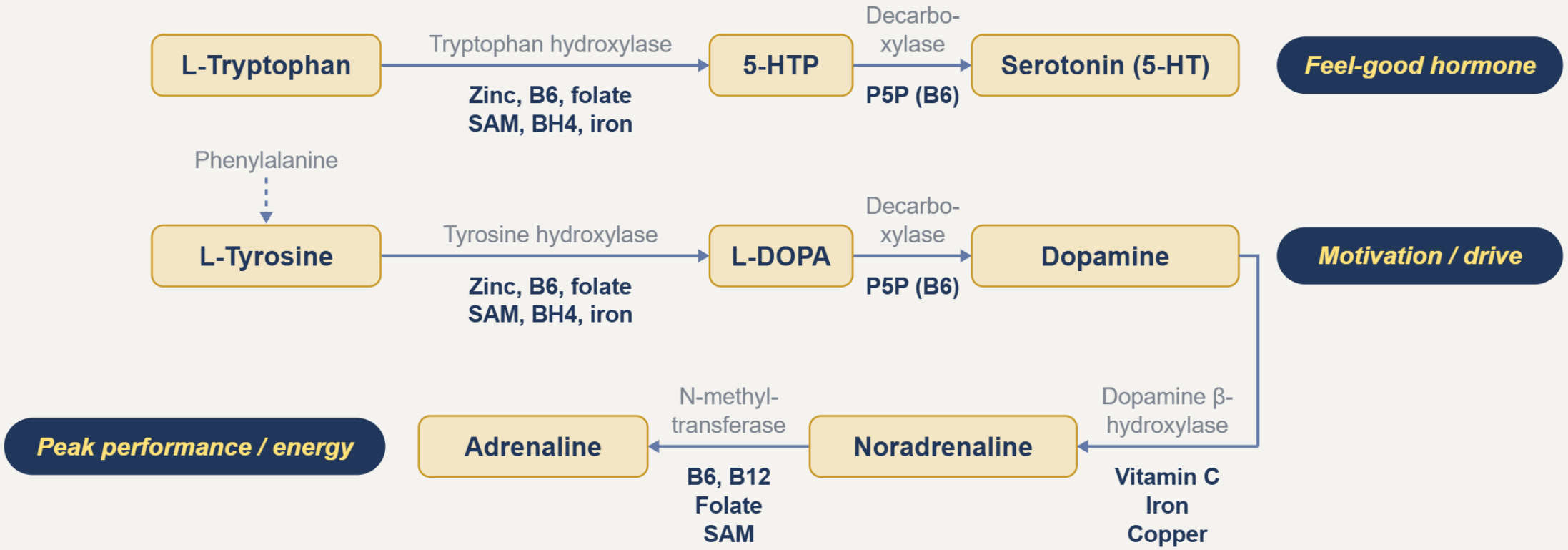
Mod. after Ober C et al., Nature Reviews Genetics 2008;9:911–922

Steroid hormone synthesis



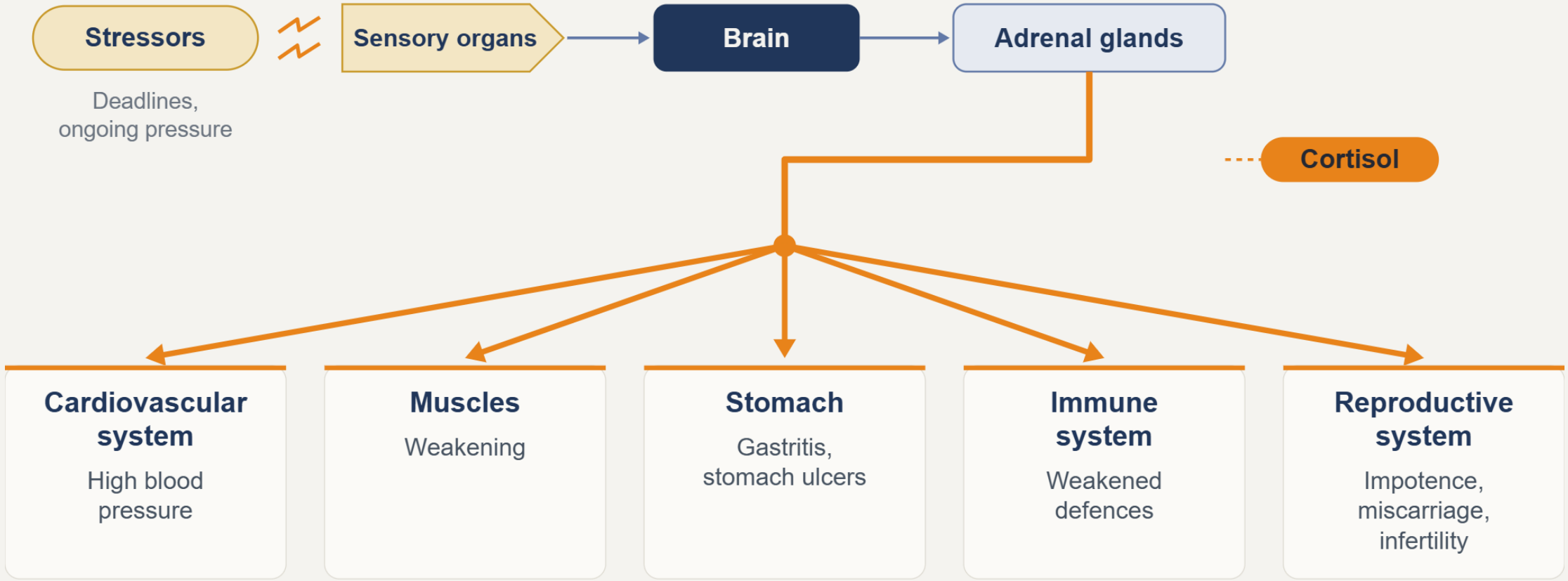
BIOCHEMISTRY

Neurotransmitter synthesis



After Gröber, Deutsche Apotheker Zeitung, 2009
SAM = S-adenosylmethionine, BH4 = tetrahydrobiopterin, P5P = pyridoxal-5-phosphate

How chronic stress affects the body



PART 1 · THE SYSTEM

One cycle, three players

01

Brain

HYPOTHALAMUS · PITUITARY

Sends the signals: **GnRH**, then **FSH** and **LH**.

02

Ovaries

FOLLICLE · CORPUS LUTEUM

Grow the egg and produce **estrogen** and **progesterone**.

03

Uterus

ENDOMETRIUM

Builds up its lining, keeps it ready, or sheds it.

Feedback loop: rising and falling ovarian hormones tell the brain what to send next.

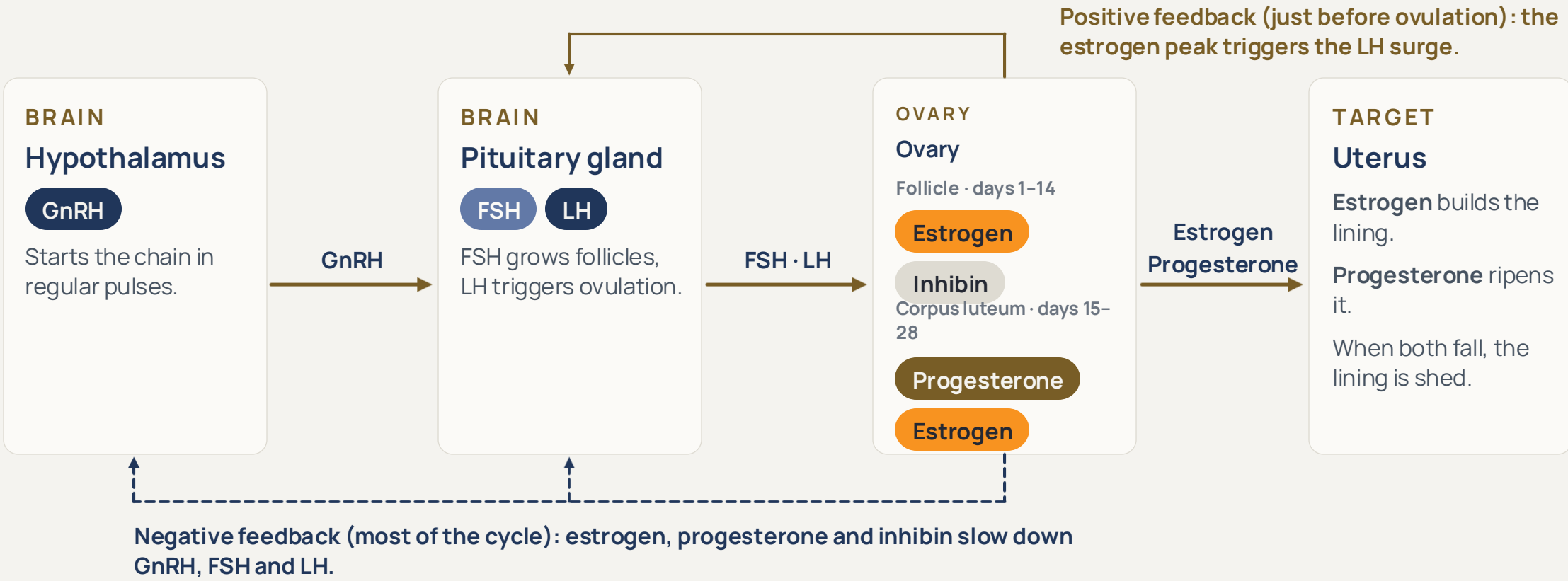
THE MESSENGERS

Five key hormones

Hormone	Made in	Main job
GnRH	Hypothalamus	Tells the pituitary to release FSH and LH
FSH	Pituitary gland	Makes the follicles grow
LH	Pituitary gland	Triggers ovulation, forms the corpus luteum
Estrogen	Growing follicle	Builds up the uterine lining
Progesterone	Corpus luteum	Prepares and holds the lining for pregnancy

DIAGRAM

The hormone axis of the cycle



OVERVIEW

The cycle at a glance

IN THE OVARY



IN THE UTERUS



Day 1 Day 7 Day 14 Day 21 Day 28

Average length: **28 days**. Anywhere from **21 to 35 days** is normal.

PHASE 1 · DAYS 1–5

Menstruation: a fresh start

Day 1 is the first day of bleeding. Hormone levels are at their lowest point.

IN THE OVARY

No hormone-producing corpus luteum is left. A new group of follicles waits for the start signal.

HORMONES

Estrogen and **progesterone** are low. The brain notices and starts releasing more **FSH**.

IN THE UTERUS

Without hormone support, last cycle's thick lining breaks down and leaves the body.

PHASE 2 · DAYS 1–13

Follicular phase: growing and building

FSH starts the next round. One follicle takes the lead and drives the cycle forward.

IN THE OVARY

FSH wakes up several follicles. Usually one becomes dominant, the others stop growing.

HORMONES

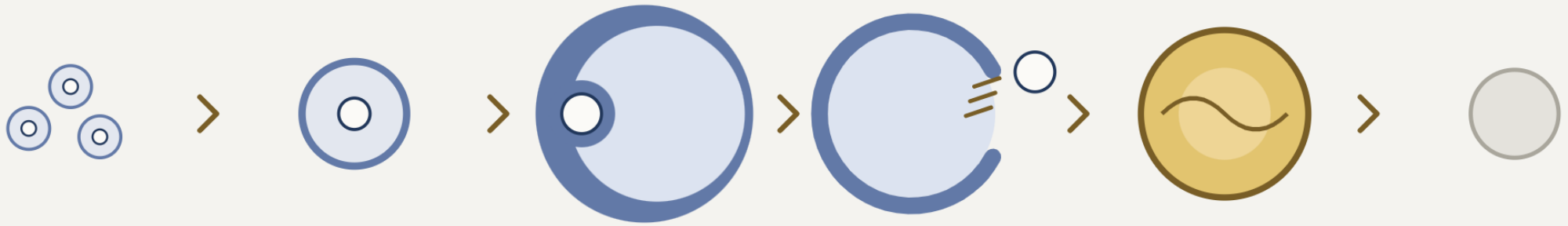
The dominant follicle produces more and more **estrogen**. Levels rise steadily.

IN THE UTERUS

Estrogen rebuilds the lining with new cells and blood vessels: the proliferative phase.

EGG DEVELOPMENT

From follicle to corpus luteum



FOLLICULAR

Resting follicles

Waiting in the ovary

FOLLICULAR

Growing follicles

FSH starts their growth

FOLLICULAR

Dominant follicle

Fluid-filled, makes estrogen

DAY 14

Ovulation

Follicle bursts, egg is released

LUTEAL

Corpus luteum

Makes progesterone

LUTEAL

Corpus albicans

Scar tissue, if no pregnancy

PHASE 3 · AROUND DAY 14

Ovulation: the egg is released

Peak **estrogen** triggers a sudden **LH surge**. The mature follicle bursts and the fallopian tube catches the egg.

24–36 h

LH SURGE → OVULATION

Time from the LH peak until the follicle releases the egg.

12–24 h

EGG SURVIVAL

The window in which the egg can be fertilized.

≈ 5 days

SPERM SURVIVAL

So the fertile window covers the days before ovulation plus the day itself.

PHASE 4 · DAYS 15–28

Luteal phase: preparing the nest

The empty follicle turns into the corpus luteum, a small temporary hormone gland.

IN THE OVARY

The **corpus luteum** lives about 10–14 days and produces hormones the whole time.

HORMONES

Progesterone rises sharply, with some estrogen. Body temperature rises by 0.3–0.5 °C.

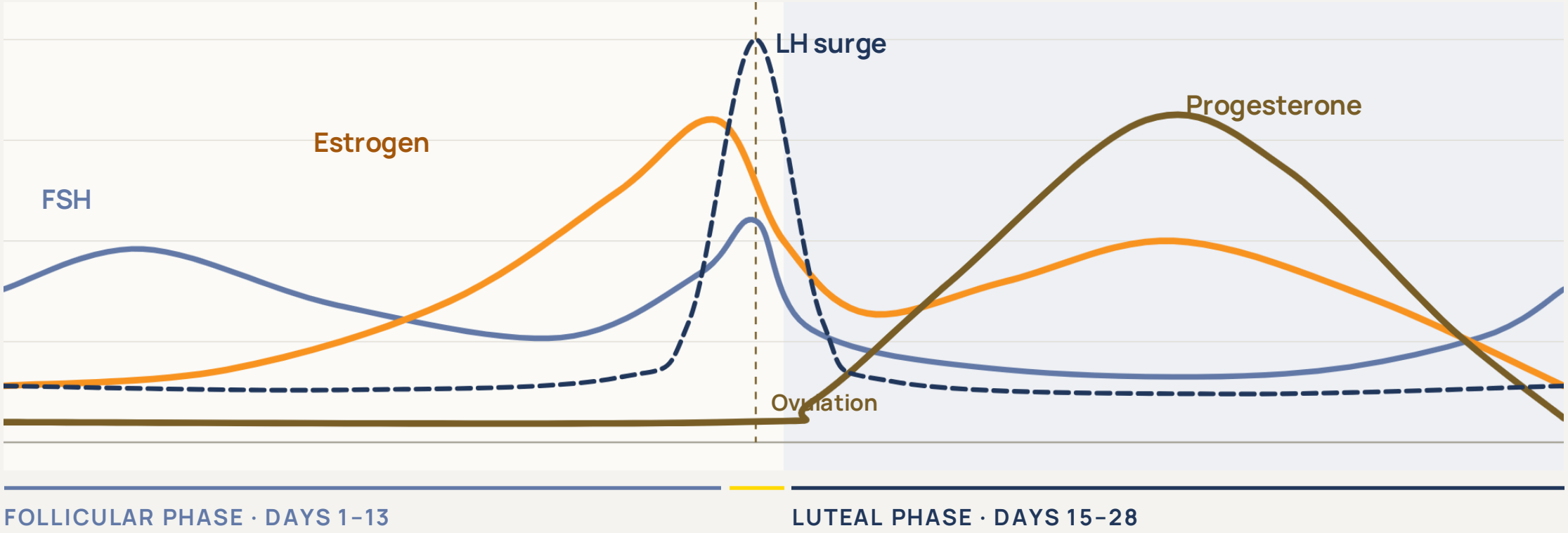
IN THE UTERUS

Progesterone turns the lining into a soft, nutrient-rich nest: the secretory phase.

DIAGRAM

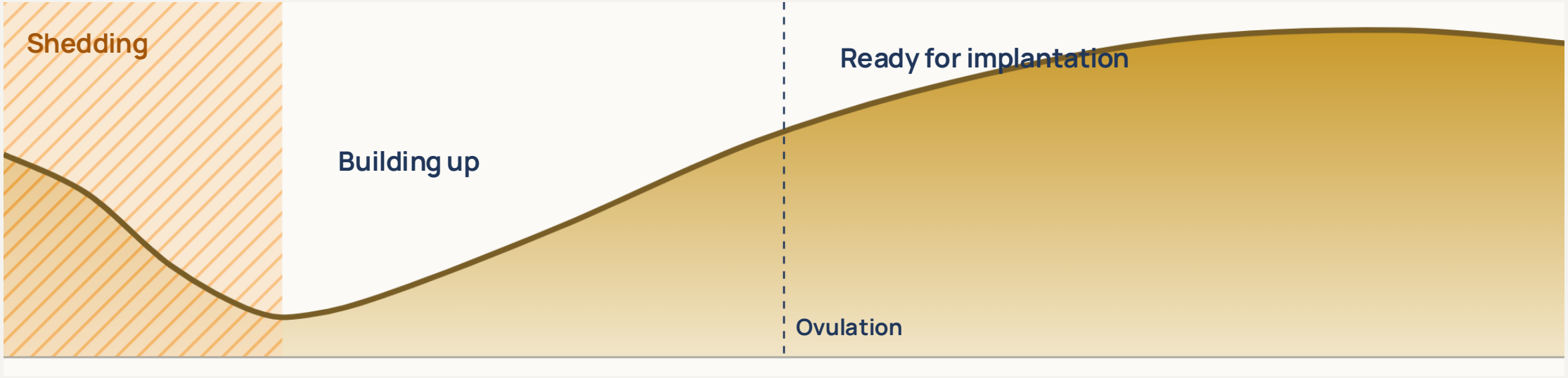
Hormone levels over 28 days

Schematic: relative levels, not measured values



DIAGRAM

The uterine lining across the cycle



Days 1–5	Days 6–14	Days 15–28
Hormones low	Driven by estrogen	Driven by progesterone

THE END OF THE CYCLE

Two possible endings

No pregnancy

1. The corpus luteum breaks down after 10–14 days.
2. Progesterone and estrogen drop sharply.
3. The lining can't be held and is shed.
4. The period begins: a new day 1.

Pregnancy

1. The embryo produces the hormone **hCG**.
2. hCG keeps the corpus luteum alive.
3. Progesterone stays high, the lining is maintained.
4. No period. hCG is what pregnancy tests detect.

SUMMARY · PART 1

The whole cycle in one chain

01

Brain sends **FSH**

02

Follicle grows, makes **estrogen**

03

Estrogen builds the lining

04

LH surge releases the egg

05

Corpus luteum makes **progesterone**

06

No pregnancy: hormones fall, lining sheds

PART 2

Menopause: when the cycle ends

Why the cycle slows down, which hormones change first, and what a new hormonal balance looks like.

THE STARTING POINT

A limited supply of follicles

A woman is born with her entire supply of follicles. **No new ones are ever made.** Each cycle, a whole group starts to grow, but usually only one ovulates.

1–2 million

AT BIRTH

The complete lifetime supply of follicles.

300–400k

AT PUBERTY

Already most of the supply is gone before the first period.

≈ 400

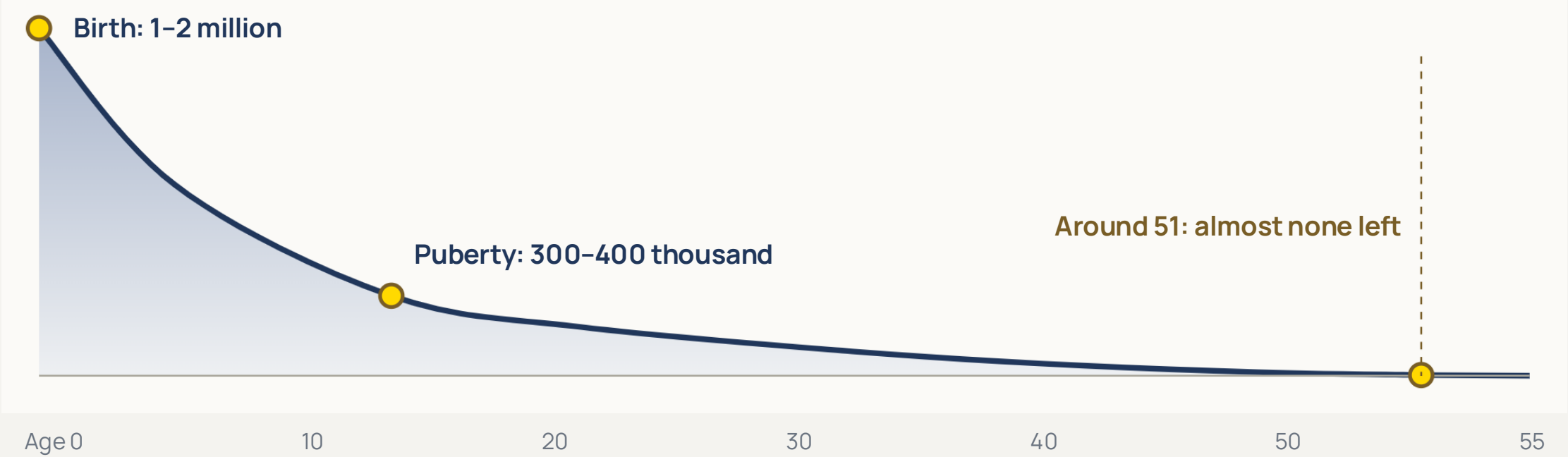
OVULATIONS

Only a tiny share ever ovulates. The rest are lost along the way.

DIAGRAM

The follicle reserve over a lifetime

Schematic: shape of the decline, not exact values



FROM THE MID-40S

The brain calls louder

01

Few follicles

IN THE OVARY

The ovaries respond more weakly to the brain's signals.

02

Less feedback

HORMONES

Fewer hormones travel back from the ovaries to the brain.

03

More FSH

PITUITARY GLAND

The brain raises **FSH** to push harder, often in vain.

Typical sign: a raised FSH level points to the transition into menopause.

THE TRANSITION

Three stages, one moment

Fertile years
Regular cycles

Perimenopause
Usually several years

Postmenopause
Everything after

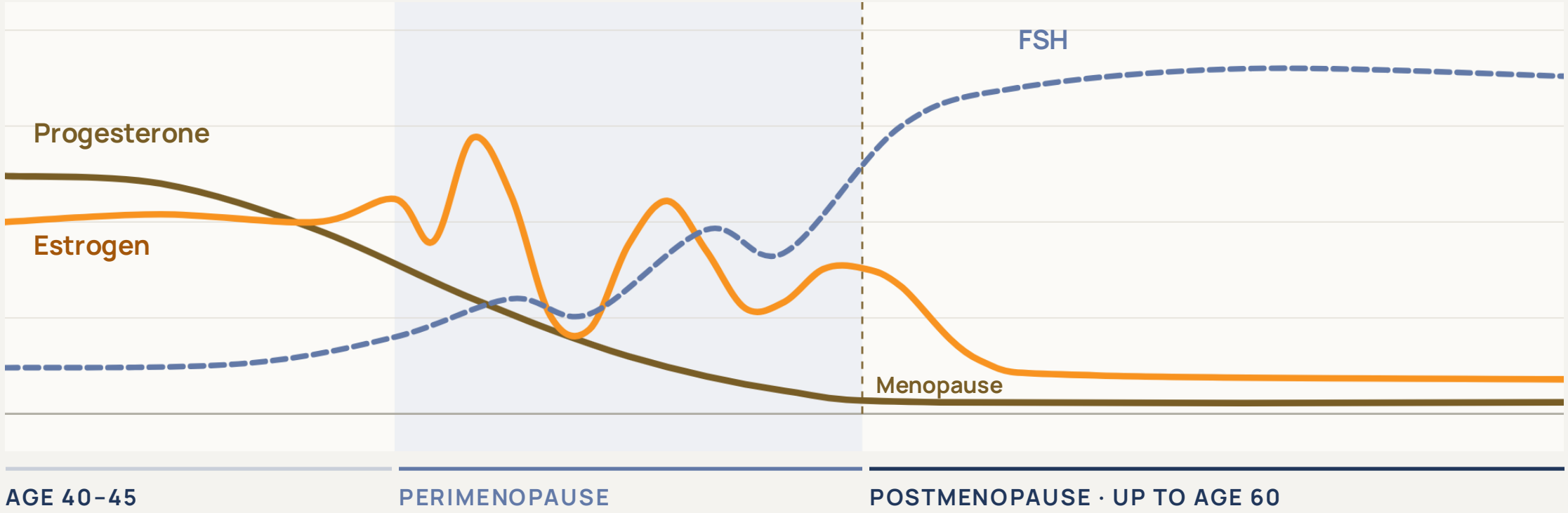
MENOPAUSE · Ø AGE 51

One single moment: the **last period**.
Confirmed only looking back, after **12 months** without bleeding.

DIAGRAM

Hormones from 40 to 60

Schematic: timing varies from woman to woman



PERIMENOPAUSE

What changes first

STEP 1

Progesterone falls

More cycles without ovulation. No ovulation means no corpus luteum, and no corpus luteum means little progesterone.

Often noticed: shorter or irregular cycles, heavier bleeding, poor sleep, restlessness.

STEP 2

Estrogen swings, then drops

Estrogen rides a rollercoaster, sometimes very high, sometimes very low. Only later does it fall for good.

Often noticed: hot flashes, mood swings, changes in sleep and wellbeing.

POSTMENOPAUSE

A new hormonal balance

WHERE ESTROGEN COMES FROM NOW

The ovaries make almost none. A small amount is still made in **fat tissue**, which converts precursors from the **adrenal glands** into a weaker form of estrogen.

TYPICAL EFFECTS OF LOW ESTROGEN

Hot flashes
Sudden waves of heat, often with sweating.

Sleep
Harder to fall asleep or to stay asleep.

Mood
Mood swings and lower resilience.

Mucous membranes
Drier skin, eyes and intimate area.

Bones
Bone loss speeds up without estrogen's protection.

SUMMARY · PART 2

Menopause in one chain

01

The **egg supply** runs out

02

Ovulation stops

03

Progesterone falls first

04

Estrogen swings, then declines

05

The brain raises **FSH** in vain

06

Periods stop: **menopause**

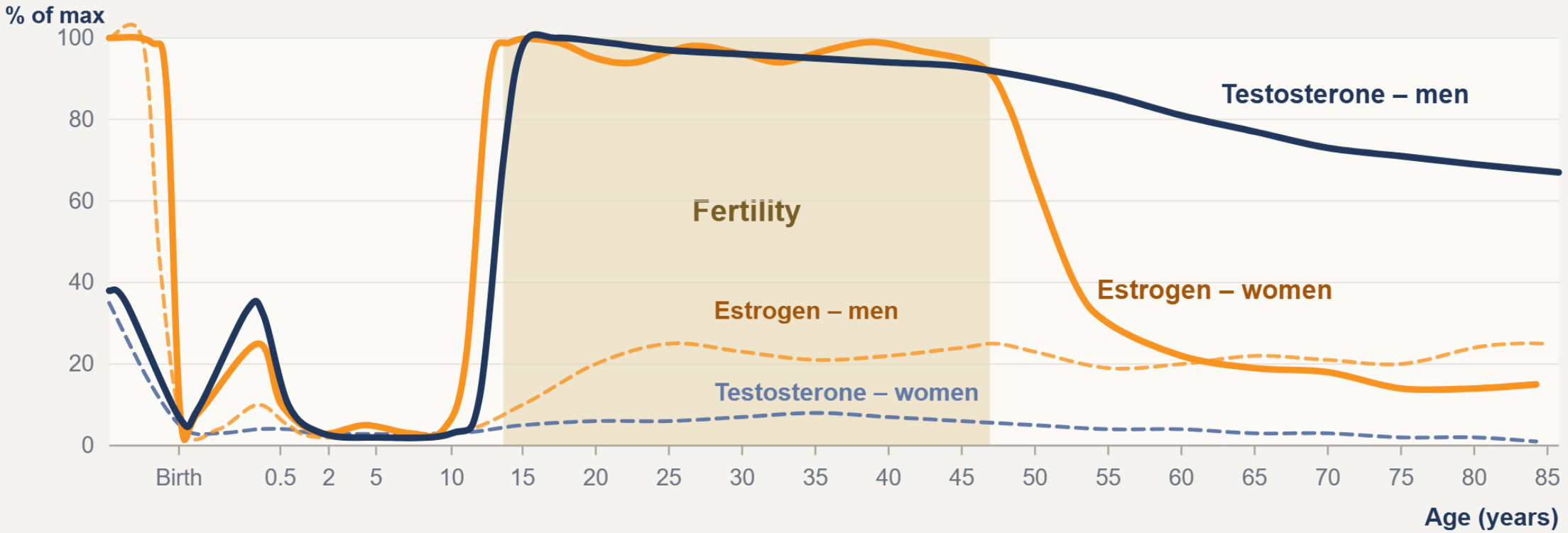
OPTI ACADEMY · HORMONE BASICS

The Male Hormone Cycle & Andropause

How testosterone is made and controlled: the brain–testes axis, the daily rhythm, sperm production, and the slow change with age.

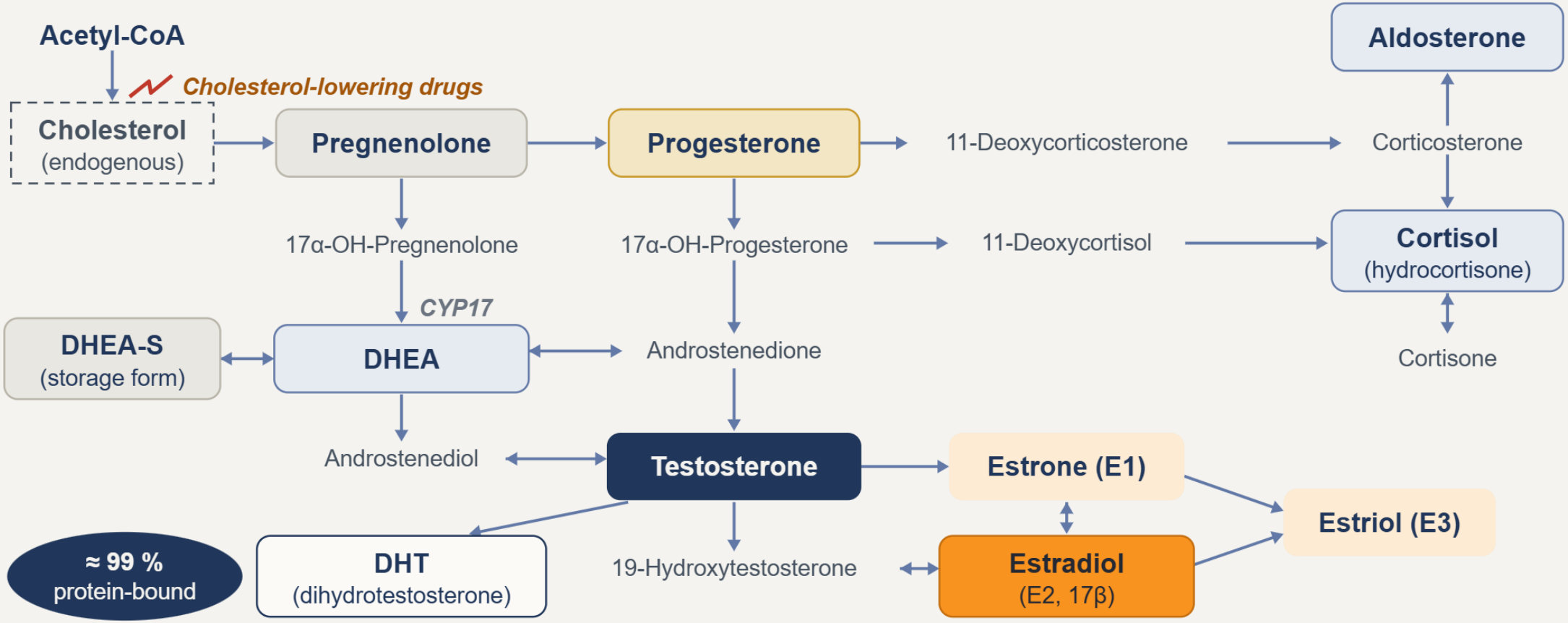
THE BIG PICTURE

Estrogen and testosterone across life

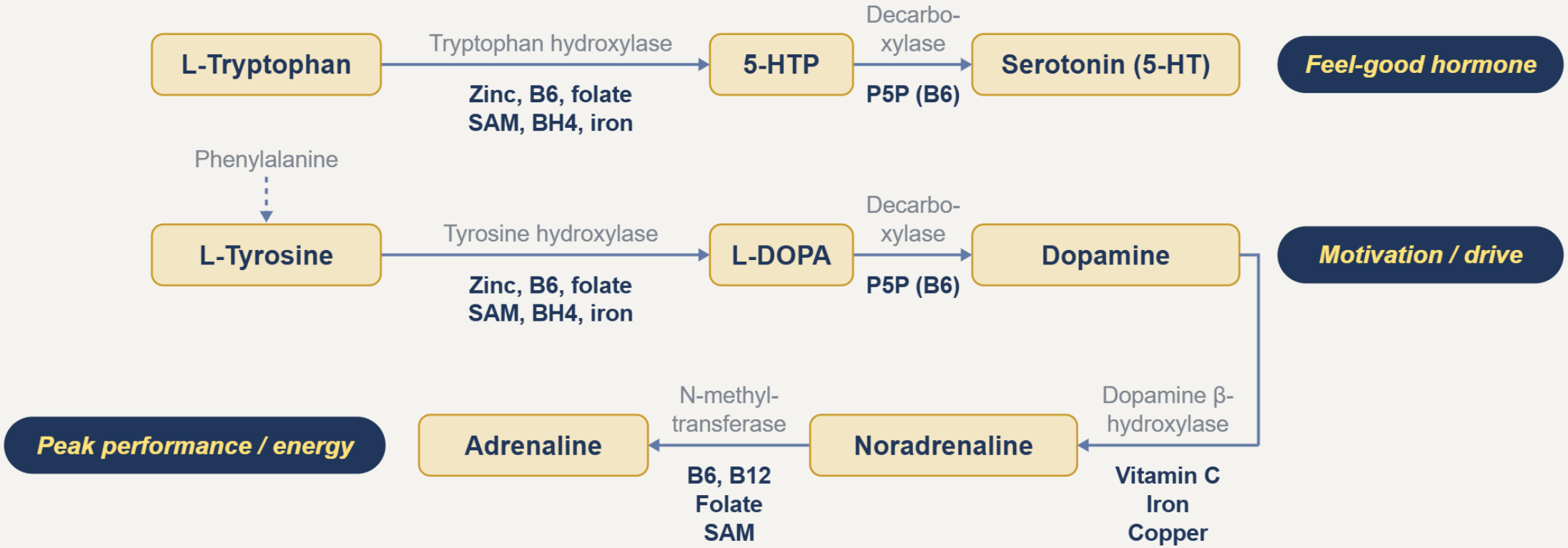


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Steroid hormone synthesis

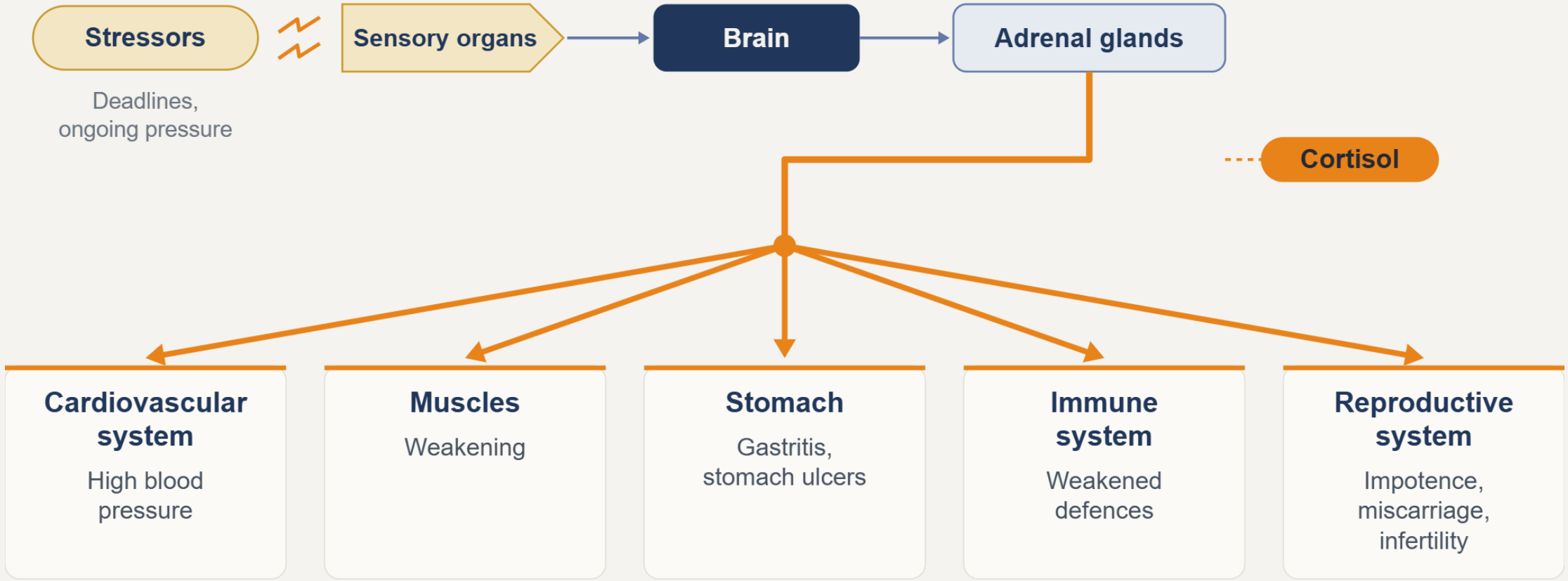


Neurotransmitter synthesis



After Gröber, Deutsche Apotheker Zeitung, 2009
SAM = S-adenosylmethionine, BH4 = tetrahydrobiopterin, P5P = pyridoxal-5-phosphate

How chronic stress affects the body



One axis, three players

01

Brain

HYPOTHALAMUS · PITUITARY

Sends the signals: **GnRH**, then **LH** and **FSH**.

02

Testes

LEYDIG · SERTOLI CELLS

Leydig cells make **testosterone**. Sertoli cells nurse sperm and make **inhibin B**.

03

Target tissues

MUSCLE · BONE · BRAIN

Respond to testosterone and its products, **DHT** and **estradiol**.

Feedback loop: high testosterone tells the brain to slow down, low testosterone tells it to speed up.

THE MESSENGERS

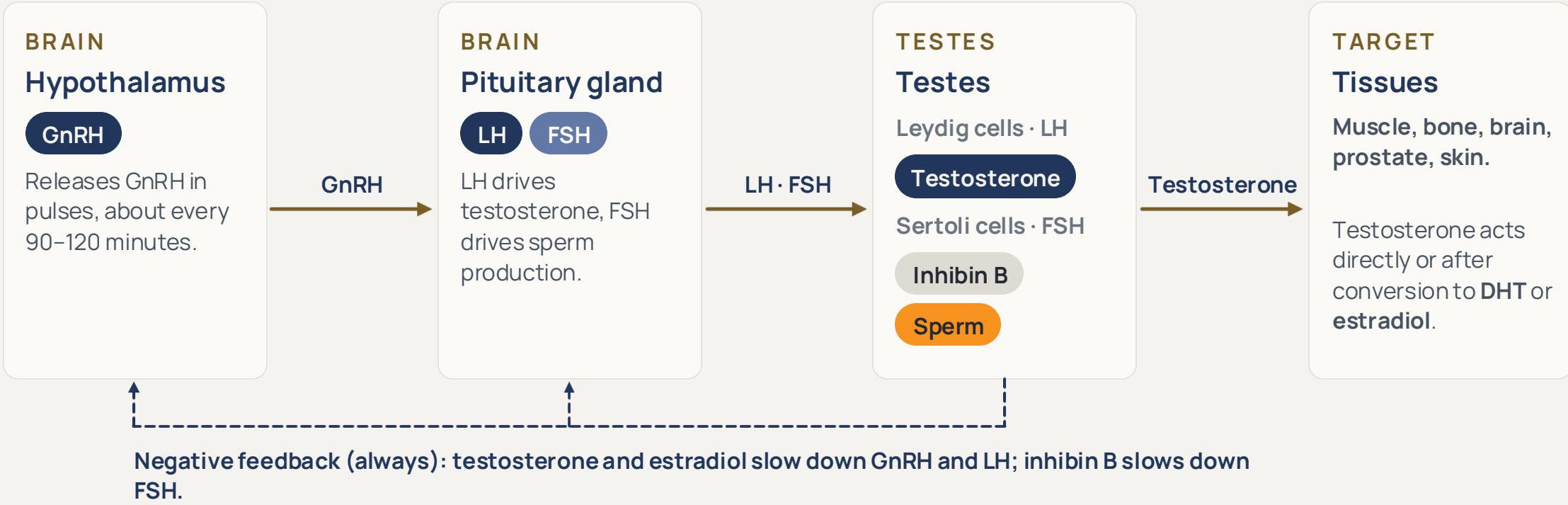
Seven key hormones

Hormone	Made in	Main job
GnRH	Hypothalamus	Tells the pituitary to release LH and FSH
LH	Pituitary gland	Makes Leydig cells produce testosterone
FSH	Pituitary gland	Supports sperm production in Sertoli cells
Testosterone	Leydig cells	Muscle, bone, libido, sperm, drive
DHT	From testosterone (5α-reductase)	Prostate, body hair, skin
Estradiol	From testosterone (aromatase)	Bone, brain, libido; more in fat tissue
Inhibin B	Sertoli cells	Brakes FSH release

DIAGRAM

The male hormone axis

No positive feedback, no LH surge: that is why the male system stays steady instead of cycling monthly.



OVERVIEW

Four rhythms in one system

≈ 90 min

HOURS

Pulses

LH is released in bursts. Testosterone follows shortly after each one.

24 h

DAILY

Day rhythm

Highest in the early morning, lowest in the evening. Built up during sleep.

≈ 70 days

WEEKS

Sperm cycle

From stem cell to mature sperm. Running non-stop, in overlapping waves.

Decades

LIFELONG

Life curve

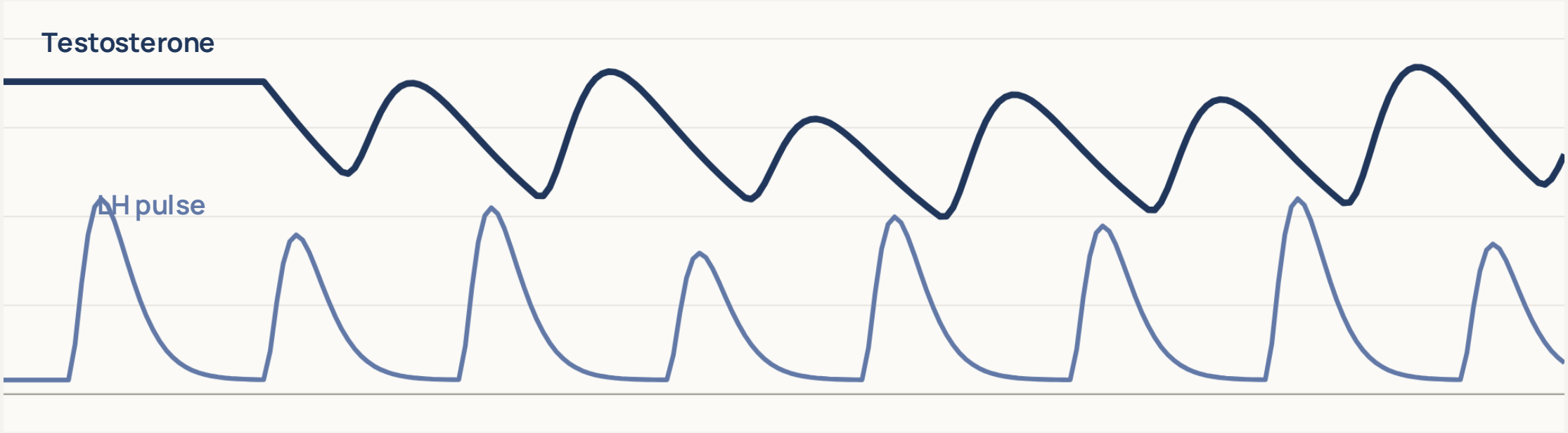
Rises in puberty, peaks in early adulthood, declines slowly from about 35–40.

Men have **no monthly hormone cycle**. The male hormone rhythm that matters day to day is the **24-hour rhythm**.

DIAGRAM

Hour by hour: LH pulses drive testosterone

Schematic, relative levels, not measured values

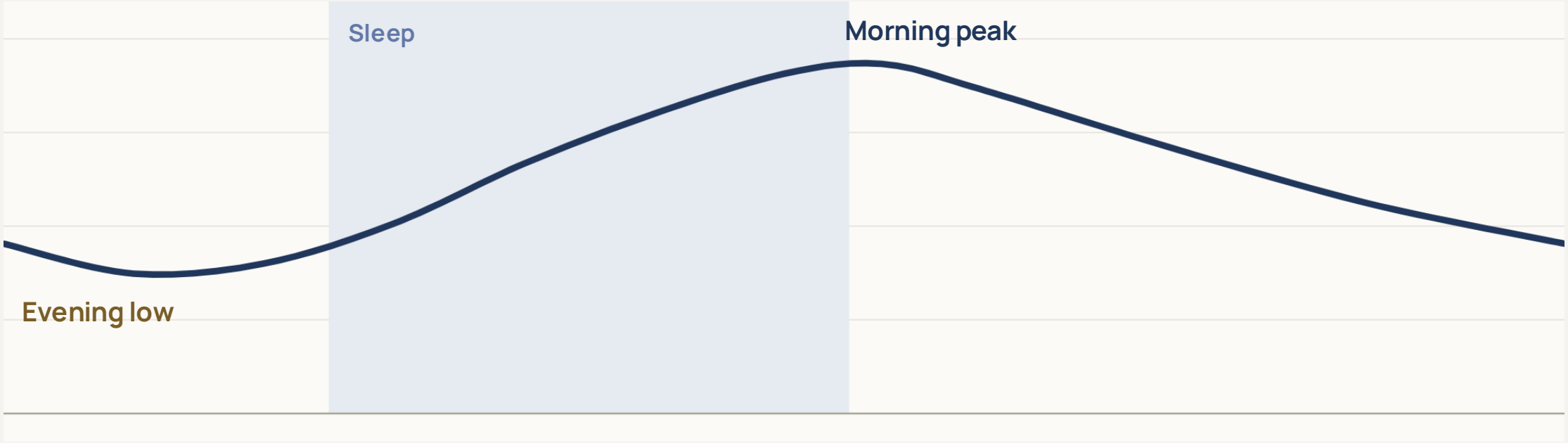


Each LH pulse is followed by a rise in testosterone. The bursts smooth out into a wave-like level in the blood.

DIAGRAM

The 24-hour testosterone rhythm

Schematic: relative levels, not measured values



In younger men the evening level is roughly 20–30 % below the morning peak.

THE DAILY RHYTHM

Night builds, morning peaks, evening dips

The 24-hour rhythm has three practical phases.

NIGHT · SLEEP

Build-up

Testosterone **climbs during sleep**, closely linked to the first sleep cycles.

MORNING · 6–9 A.M.

Peak

Highest level of the day. This is why blood is tested in the morning.

EVENING · FROM 6 P.M.

Low point

Lowest level of the day, clearly below the morning value.

Lab tip: measure fasting, between 7 and 11 a.m., and confirm a low result on a second morning.

SLEEP AND TESTOSTERONE

Short sleep, lower testosterone

Because testosterone is built up at night, sleep is one of its strongest daily drivers.

5 h

SLEEP PER NIGHT

Restricted for one week in young, healthy men.

−10–15 %

DAYTIME TESTOSTERONE

Similar to 10–15 years of ageing.

Night

SLEEP-LINKED RISE

The rise starts with sleep, not with the clock time.

Source: Leproult & Van Cauter, JAMA 2011

THE SECOND CYCLE

Sperm production: continuous, not monthly

A woman releases one egg per cycle. The testes produce sperm non-stop, from puberty into old age.

≈ 64–74

DAYS

From stem cell to mature sperm.

Millions

EVERY DAY

New sperm, produced in overlapping waves.

FSH + T

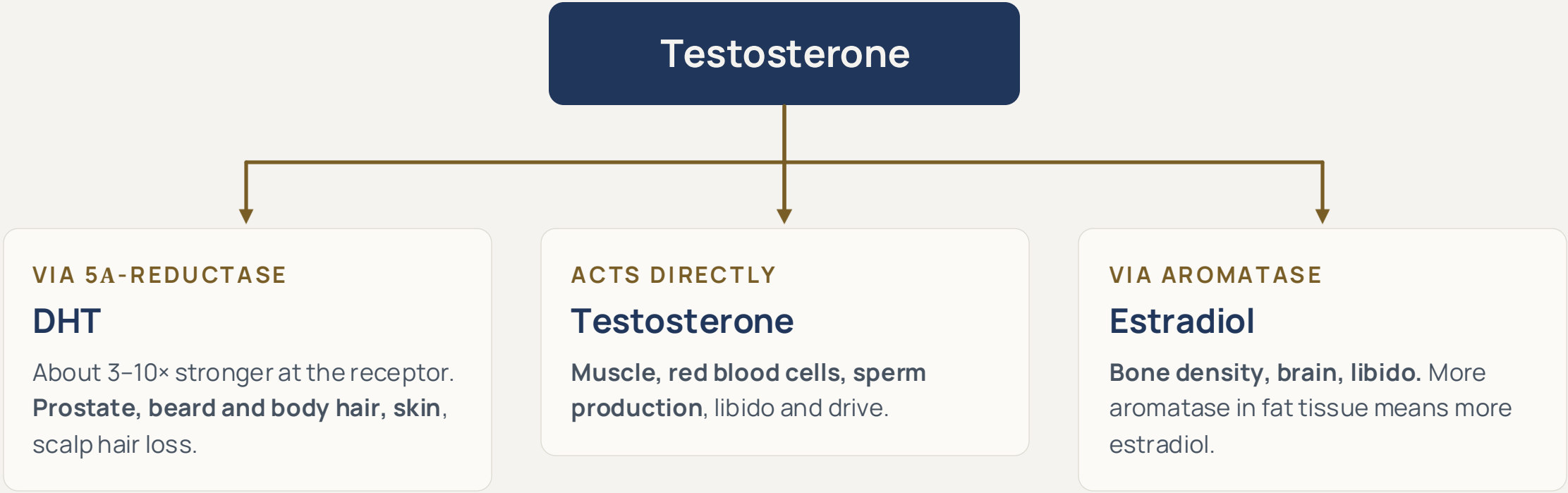
BOTH NEEDED

FSH and testosterone act on the Sertoli cells.

Testosterone inside the testes is many times higher than in blood. Testosterone from outside lowers LH and FSH and can **shut sperm production down**.

DIAGRAM

One hormone, three paths



IN THE BLOOD

Only a small share is free

Testosterone travels bound to two proteins. Only the free and the loosely bound part can act.

≈ 2 %

FREE

Active immediately.

≈ 54 %

ALBUMIN-BOUND

Loosely bound, easily released. Free + albumin = **bioavailable**.

≈ 44 %

SHBG-BOUND

Tightly bound, largely inactive. SHBG rises with age.

Total testosterone can look normal while **free testosterone is low**, for example when SHBG is high.

MEN VS. WOMEN

Two systems compared

	Men	Women
Main rhythm	Daily, 24 hours	Monthly, ≈ 28 days
Feedback	Negative only	Negative + positive (LH surge)
Gametes	New sperm every day	One egg per cycle, finite reserve
Main sex hormones	Testosterone	Estrogen and progesterone
With age	Slow decline over decades	Menopause: the cycle ends

SUMMARY · PART 1

The male system in one chain

01

Hypothalamus pulses **GnRH**

02

Pituitary releases **LH** and **FSH**

03

LH: Leydig cells make **testosterone**

04

FSH + testosterone: **sperm** production

05

Testosterone acts directly or as **DHT** and **estradiol**

06

Negative feedback keeps levels steady

PART 2

Andropause: the slow decline

How testosterone changes from the mid-30s on, why it happens, and how it differs from menopause.

THE NUMBERS

A slow, steady decline

From the mid-30s, testosterone falls gradually. Free testosterone falls faster, because SHBG rises at the same time.

−1.6 %

TOTAL TESTOSTERONE

Per year, on average.

−2 to −3 %

FREE TESTOSTERONE

Per year, on average.

+1.3 %

SHBG

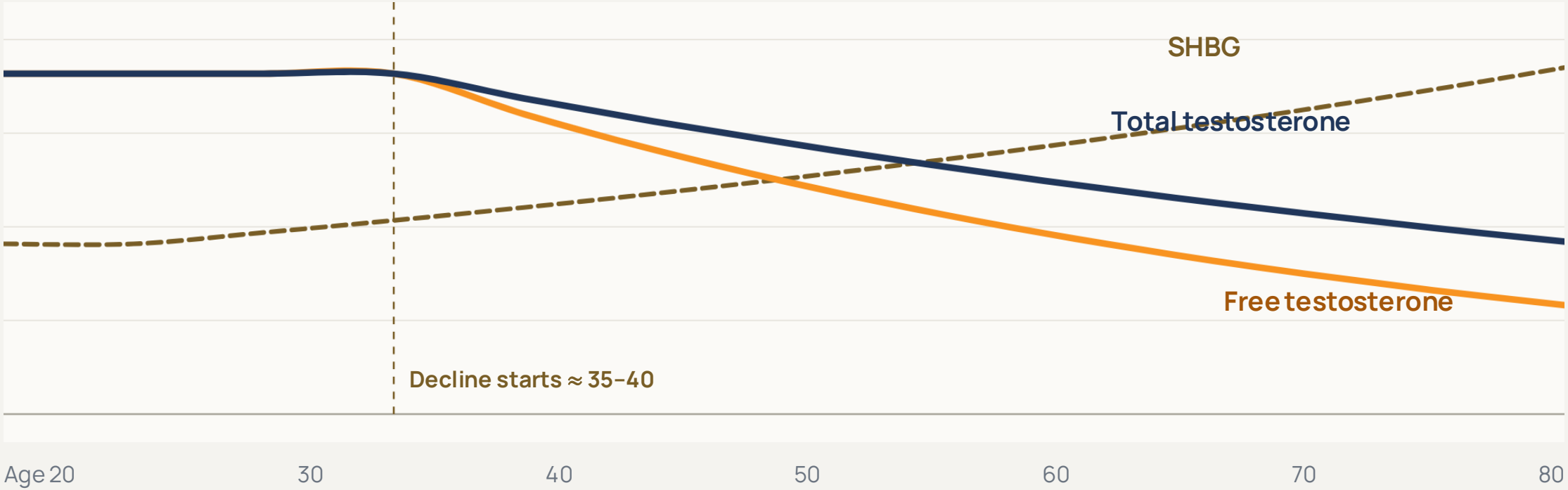
Per year, binding more testosterone.

Source: Massachusetts Male Aging Study, Feldman et al., J Clin Endocrinol Metab 2002

DIAGRAM

Testosterone across the lifespan

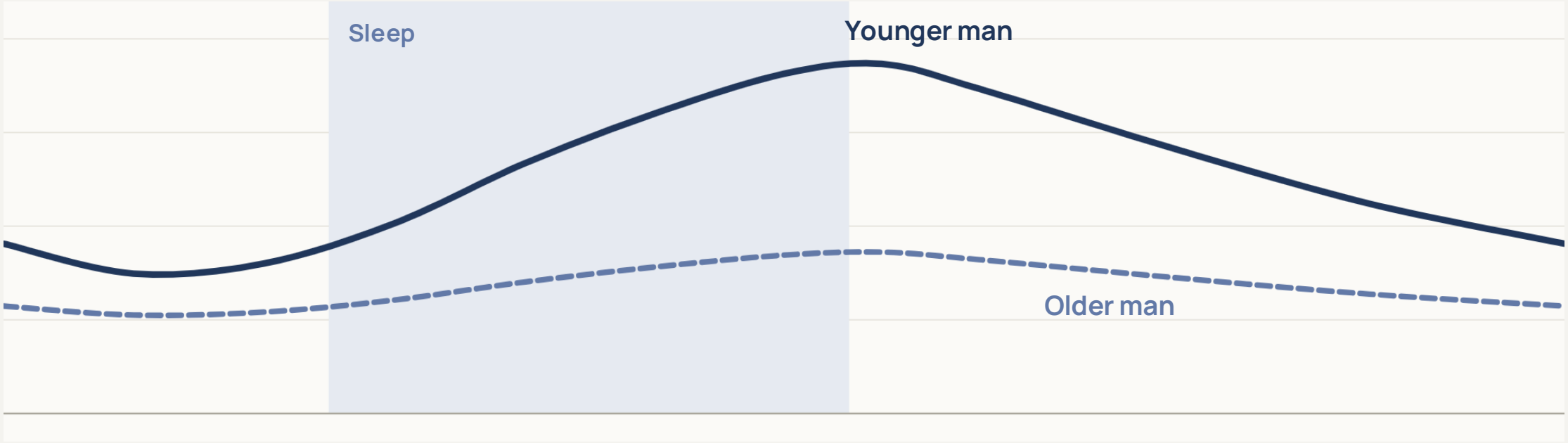
Schematic: relative levels, not measured values



DIAGRAM

The daily rhythm flattens with age

Schematic: relative levels, not measured values



Older men: lower levels overall and a much smaller morning peak.

WHY LEVELS FALL

Three causes, several amplifiers

IN THE TESTES

Testes

Fewer and less responsive **Leydig cells** make less testosterone.

IN THE BRAIN

Brain

GnRH and LH pulses become weaker and less regular.

IN THE BLOOD

Blood

More **SHBG** binds testosterone, so less is free.

Amplifiers: belly fat (more aromatase), poor sleep, chronic stress, alcohol, inactivity, chronic illness.

A MALE MENOPAUSE?

Andropause is not menopause

	Menopause	Andropause
Who	Every woman	Some men noticeably
Speed	Within a few years	Over decades
Hormones	Ovarian hormones drop sharply	≈ 1–2 % per year
Fertility	Ends	Usually continues

Only about **2 %** of men aged 40–79 have symptomatic age-related low testosterone (EMAS, Wu et al., NEJM 2010).

Typical signs

SEXUAL

Lower libido, fewer morning erections, erectile problems.

PHYSICAL

Less muscle, more belly fat, lower bone density, fatigue.

MENTAL

Low mood, poor concentration, less drive, poorer sleep.

Diagnosis needs both: typical symptoms and low morning testosterone, confirmed on two separate days.

SUMMARY · PART 2

Andropause in one chain

01

From ≈ 35–40, testosterone falls **≈ 1–2 % per year**

02

SHBG rises, free testosterone falls faster

03

The **daily rhythm** flattens, the morning peak shrinks

04

Leydig cells and brain signals weaken

05

Lifestyle factors can speed it up

06

Unlike menopause: **gradual**, fertility remains

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opti-life.com