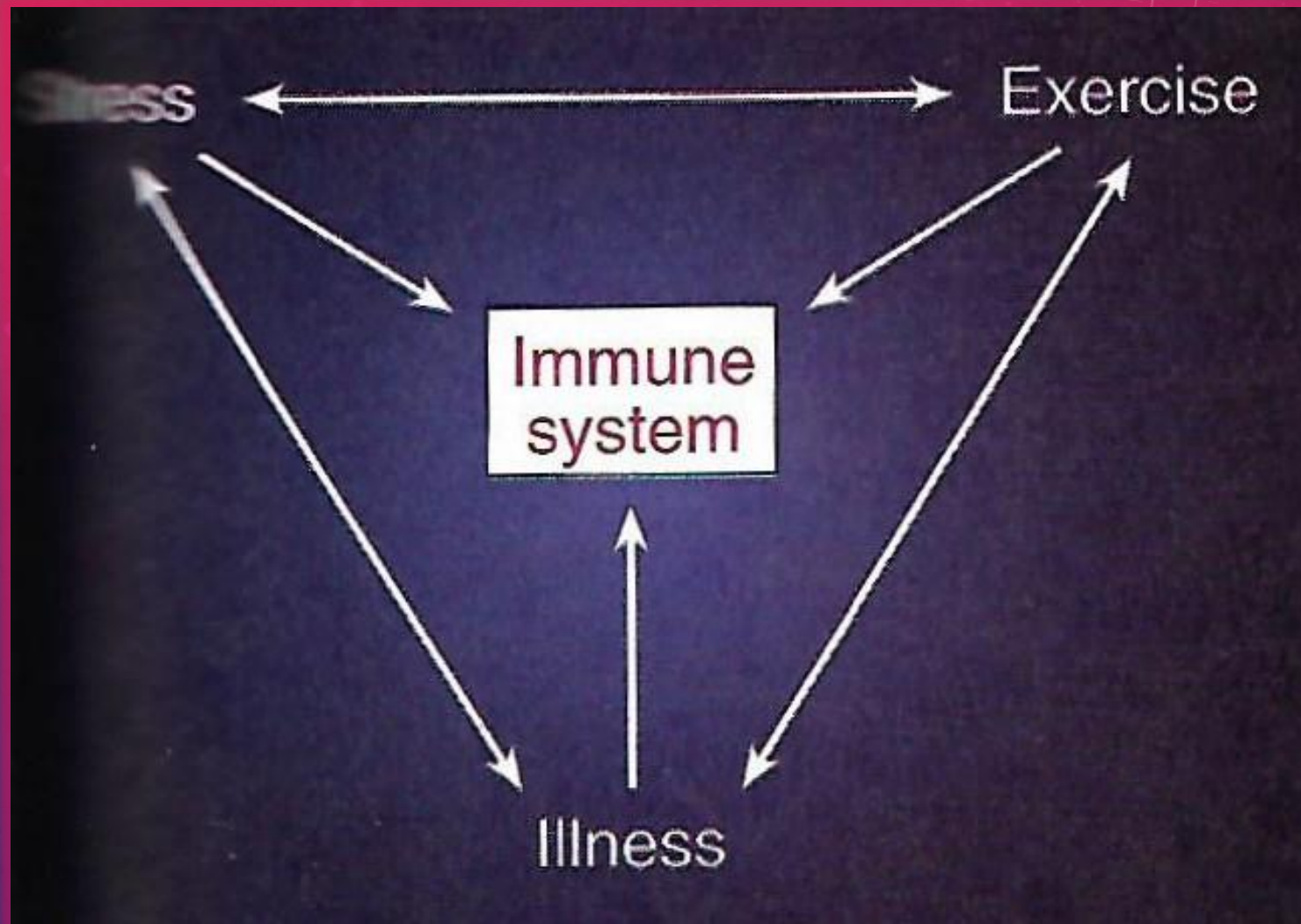
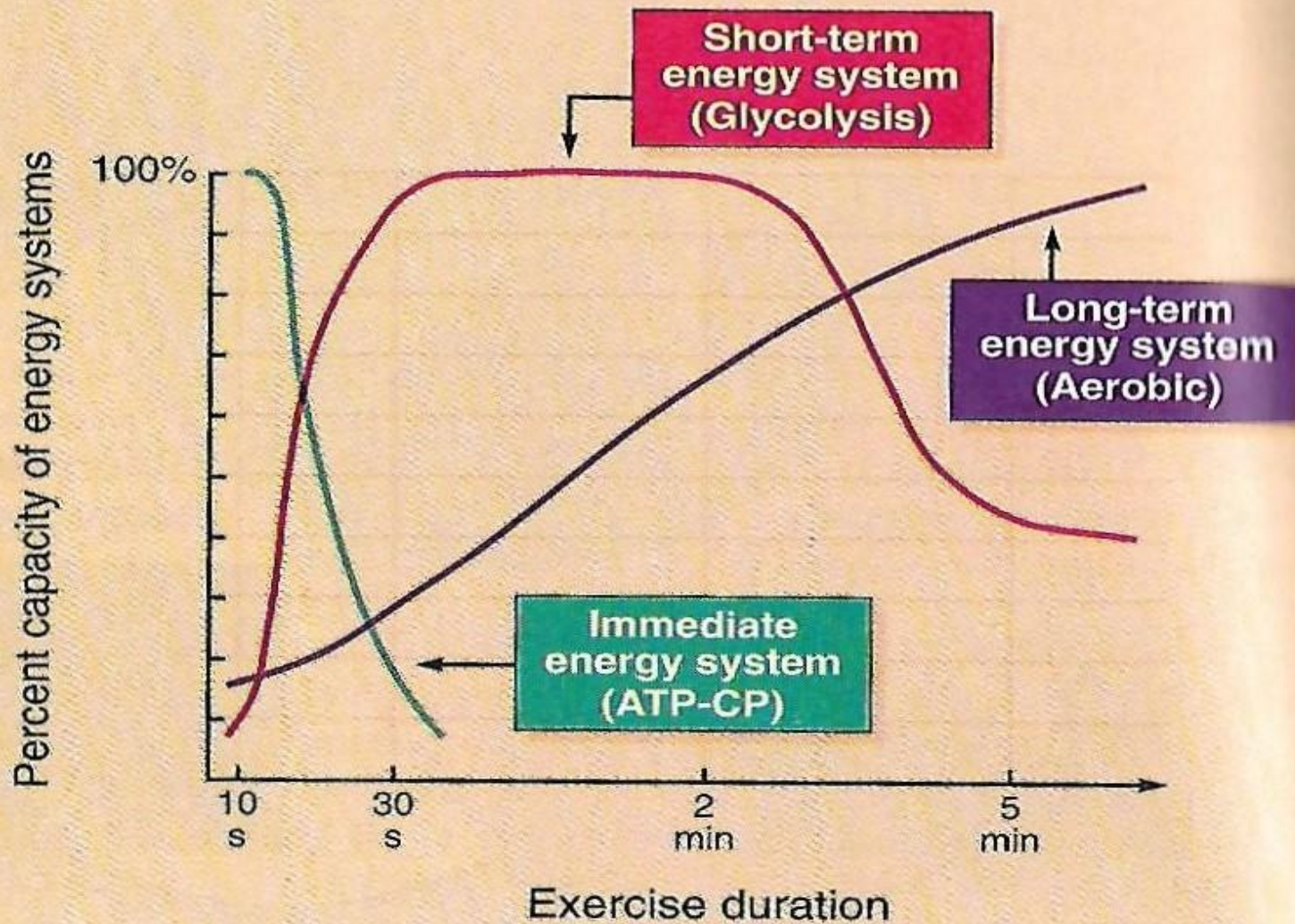
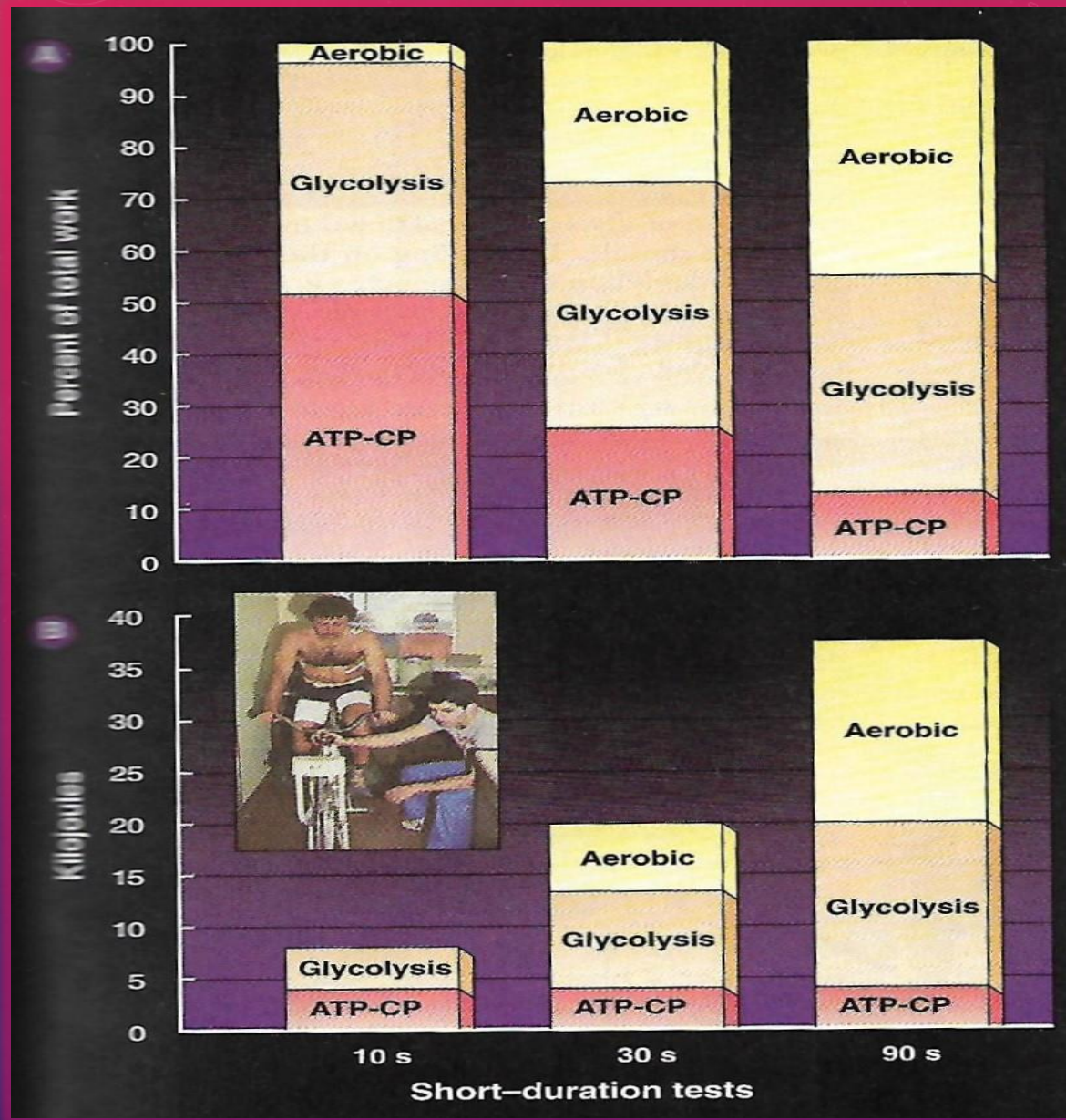
The background is a gradient from dark red at the top to dark blue at the bottom. It features several faint, white, concentric circles and a scale with numbers (160, 170, 180, 190, 230, 240, 250, 260) and arrows, suggesting a scientific or technical theme.

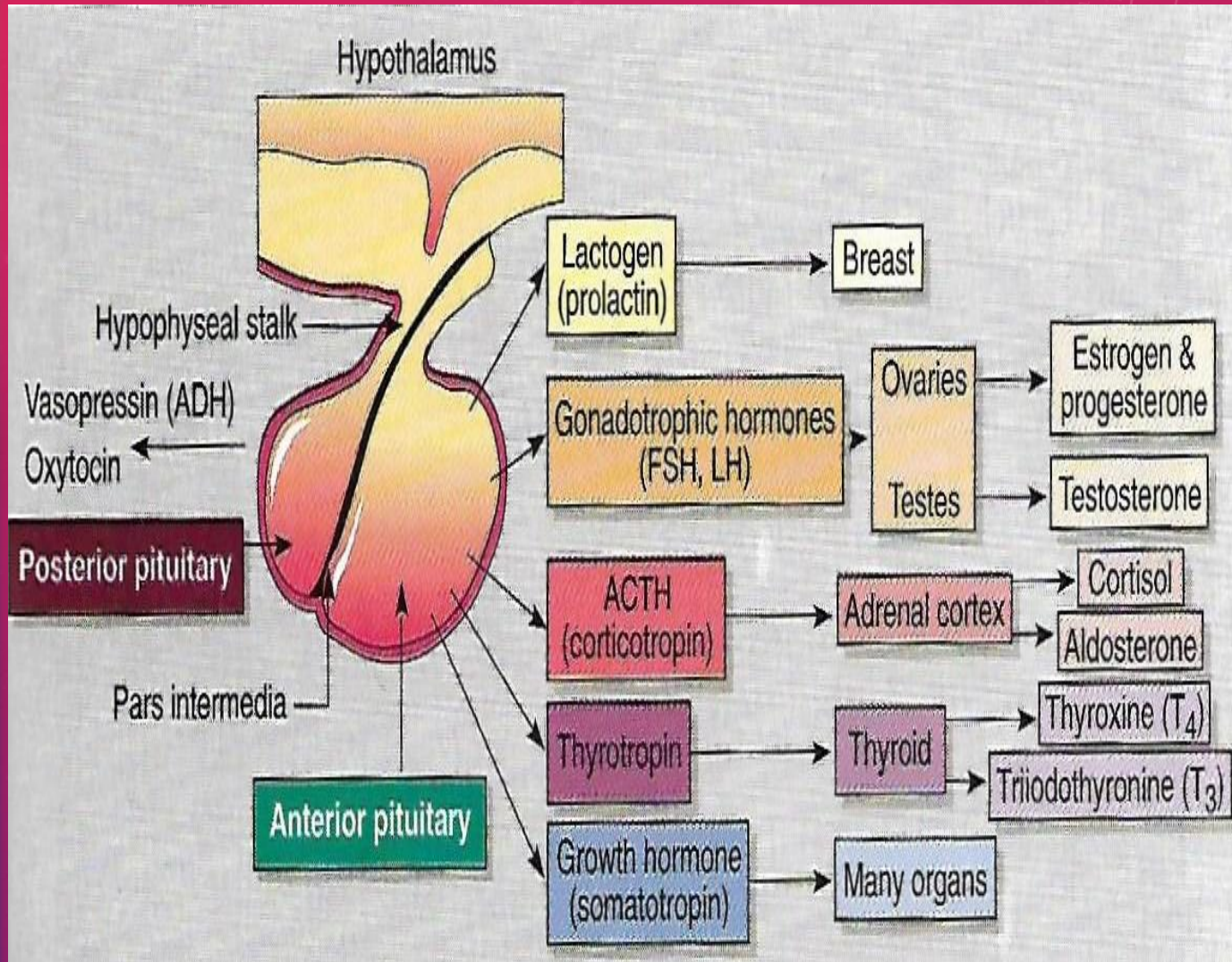
NOVA SAZNANJA O METODAMA I SREDSTVIMA U DOPINGU

**Univ Prof Vladimir Jorga MD, PhD
Beograd, 14.05.2019.**









Components of Sports Performance

Skill

speed, reflexes,
limb-eye co-
ordination,
concentration

Skill sports
(driving/riding,
target shooting)

Out of competition
Training

In competition
Beta-blockers
Stimulants

- amphetamine
- alkaloids
- glucocorticoids

Strength

muscle mass

Power sports
(lifting, throwing,
boxing, sprinting)

Androgen doping

Direct

natural, synthetic,
designer, nutraceutical
& non-steroidal
androgens

Indirect

hCG, LH, anti-estrogens
GnRH analogs

Stamina

hemoglobin &
maximal O₂
transfer

Endurance sports
(long distance or
duration events)

Blood (Hb) doping

Direct

blood transfusion

- heterologous
- autologous

Indirect

erythropoietin,
biosimilars & analogs,
hypoxia-mimetics

Recovery

tissue repair after
injury & training

Contact sports &
intense physical
training

- GH
- GH releasing
peptides (GHRH,
Ghrelin analogs)
- Growth factors

DOPING IN SPORTS

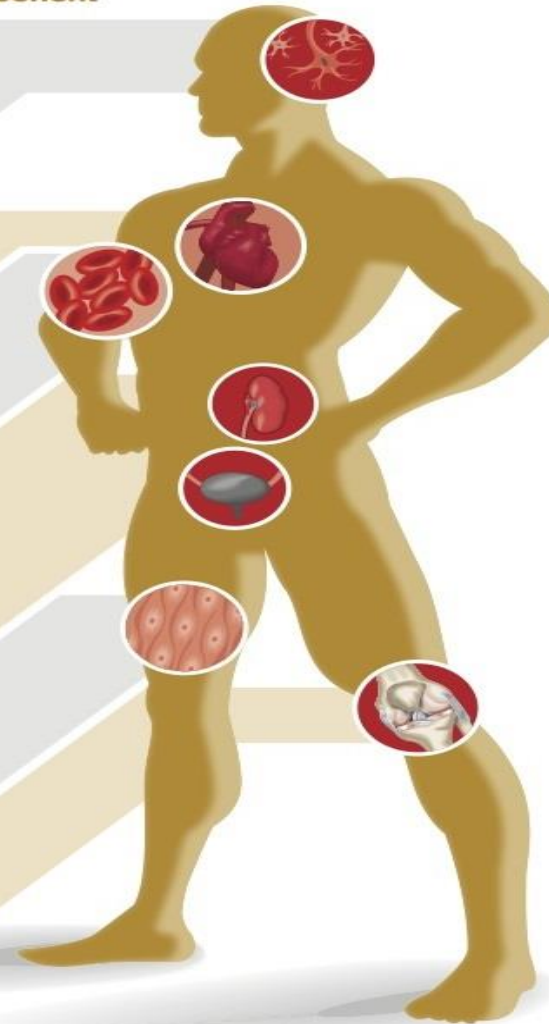
► Seven-times Tour de France champion Lance Armstrong said on Thursday he would no longer fight doping charges by the U.S. Anti-Doping Agency (USADA)

► In June, USADA charged Armstrong and said its investigation included evidence dating back to 1996, and blood samples taken from him in 2009 to 2010 are "fully consistent with blood manipulation including EPO* use and/or blood transfusions"

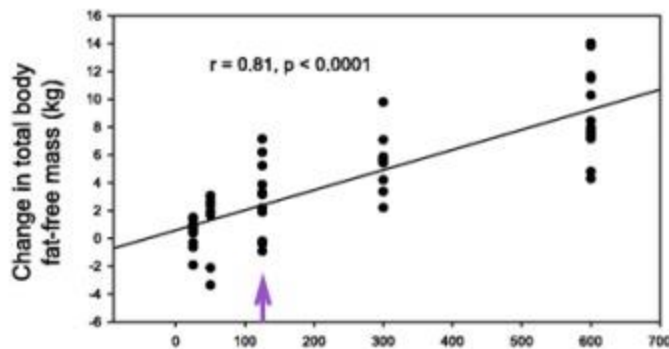
DRUG TYPES ABUSED BY ATHLETES

**EPO- Erythropoietin, is a blood- boosting drug which increases oxygen delivery*

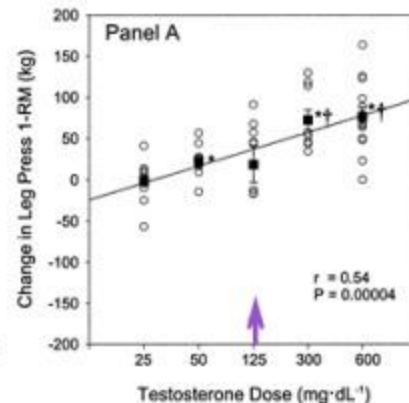
Effects to athlete	Sports of potential benefit
Enhance alertness Ampethamines • Caffeine • Cocaine •	• Baseball* • Basketball • Boxing • Cycling • Judo • Gymnastics
Relax blood vessel or heart Alcohol • Beta blockers • Cannabinoids •	• Archery • Diving • Mod. Pentathlon • Shooting
Increase oxygen delivery in tissues Protein hormones • Artificial oxygen carriers • Blood doping •	• Cycling • Marathon • Mod. Pentathlon • Skiing • Swimming
Control weight Diuretics • Mask drug use Epitestosterone • Plasma expanders • Secretion inhibitors • Diuretics •	• Athletics • Boxing • Equestrian • Judo • Rowing • Weightlifting
Build mass and strength Anabolic steroids • Human chorionic gonadotropin • Luteinizing hormone • Human growth hormone • Insulin-like growth factor • Insulin •	• Sprint events • Throwing • Weightlifting • Football • American Football
Mask pain or injury Protein hormones • Narcotics • Local anaesthetics •	• American Football • Cycling



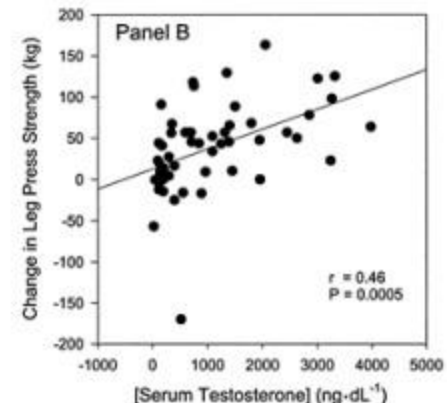
Biological Basis of Androgen Doping



Woodhouse et al. Am J Physiol 2003 284:E1009-17



Storer et al. J Clin Endocrinol Metab 2003;88:1478-1485



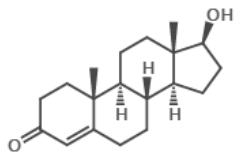
Testosterone effects on muscle mass and strength

- dose-dependent from below to beyond the physiological range
- increase +10% without, and +20-37% with exercise (exercise alone +10-20%)
- additive effects from increased hemoglobin (+3%)
- not at plateau – possibly even greater effects at higher doses

A BRIEF GUIDE TO DOPING IN SPORTS

Doping in sports has been in the news in the run up to the Olympics. What drugs will doping tests at the Olympics be looking for? This graphic looks at some of the major groups of drugs used in doping, their effects, and why athletes might take them.

ANABOLIC AGENTS



TESTOSTERONE



MUSCLE MASS & STRENGTH

74

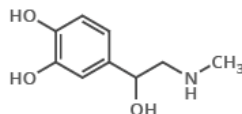
NO. OF NAMED BANNED AGENTS

48%

% OF POSITIVE TESTS IN 2014

The largest class of prohibited drugs, and the most commonly detected. Anabolic steroids mimic the hormone testosterone, increasing muscle mass and physical strength. This class also includes some non-steroidal drugs. They have a range of side effects.

STIMULANTS



ADRENALINE



ALERTNESS AND ENERGY

66

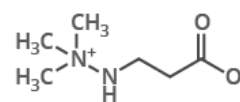
NO. OF NAMED BANNED AGENTS

15%

% OF POSITIVE TESTS IN 2014

Stimulants are used to improve alertness, attention, and energy. Many behave similarly to the hormones adrenaline and noradrenaline. They include amphetamines. Taking them can increase blood pressure and cause cardiac problems.

HORMONES AND MODULATORS



MELDONIUM



AFFECT HORMONES/METABOLISM

20

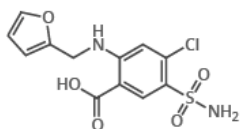
NO. OF NAMED BANNED AGENTS

5%

% OF POSITIVE TESTS IN 2014

A range of drugs which generally interfere with human hormones. They can be used with anabolic steroids, to suppress some of the undesirable effects of these drugs. Some affect oestrogen levels in the body, whereas others affect human metabolism.

DIURETICS AND MASKING AGENTS



FUROSEMIDE



HELP TO CONCEAL DOPING

22

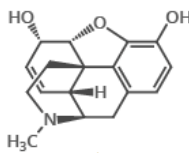
NO. OF NAMED BANNED AGENTS

13%

% OF POSITIVE TESTS IN 2014

Diuretics remove fluids from the body and can be used by athletes to regulate their body mass, as well as diluting urine so lower levels of banned substances are registered in tests. Masking agents are drugs taken to conceal the presence of illegal drugs in urine samples.

NARCOTICS



MORPHINE



INCREASE PAIN TOLERANCE

11

NO. OF NAMED BANNED AGENTS

11

% OF POSITIVE TESTS IN 2014

This class includes narcotic analgesics such as morphine and codeine which can be enhance performance by increasing a competitor's tolerance to pain. They can also reduce anxiety which can be advantageous in some sports.

OTHER BANNED SUBSTANCES



ERYTHROPOIETIN (EPO)



BETA-BLOCKER DRUGS



ALCOHOL (IN-COMPETITION)



GLUCOCORTICOSTEROIDS



CANNABIS & CANNABINOIDS



BETA-2 AGONIST DRUGS

Many more substances are banned, including EPO, which promotes red blood cell production, getting oxygen to muscles more effectively. Some substances, such as alcohol and beta-blockers, are only prohibited in-competition for some sports.



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PROHIBITED AT ALL TIMES

Substances

S0 Non-approved substances

Methods

S1 Anabolic agents

S2 Peptide hormones, growth factors, related substances and mimetics

S3 Beta-2 agonists

S4 Hormone and metabolic modulators

S5 Diuretics and masking agents

PROHIBITED IN-COMPETITION



Substances

S6

Stimulants

S7

Narcotics

S8

Cannabinoids

S9

Glucocorticoids

Substances

M1 Manipulation of blood and blood components

Methods

M2 Chemical and physical manipulation

M3 Gene and cell doping