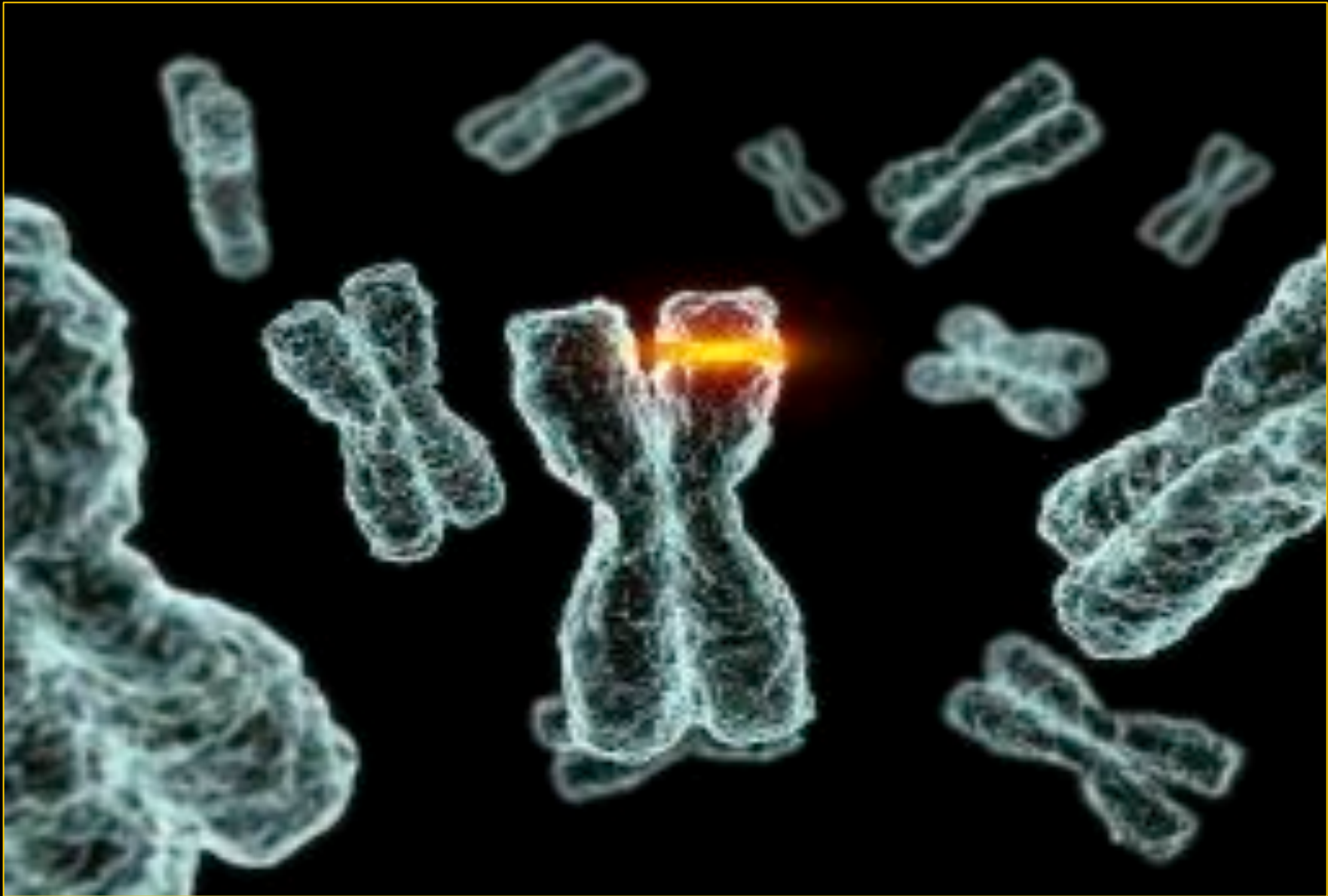




ASPC  
International  
Forum on  
**ELITE  
SPORT**

Human Performance Project

John Underwood



# Human Performance Project



# Human Performance Project





# Lake Placid

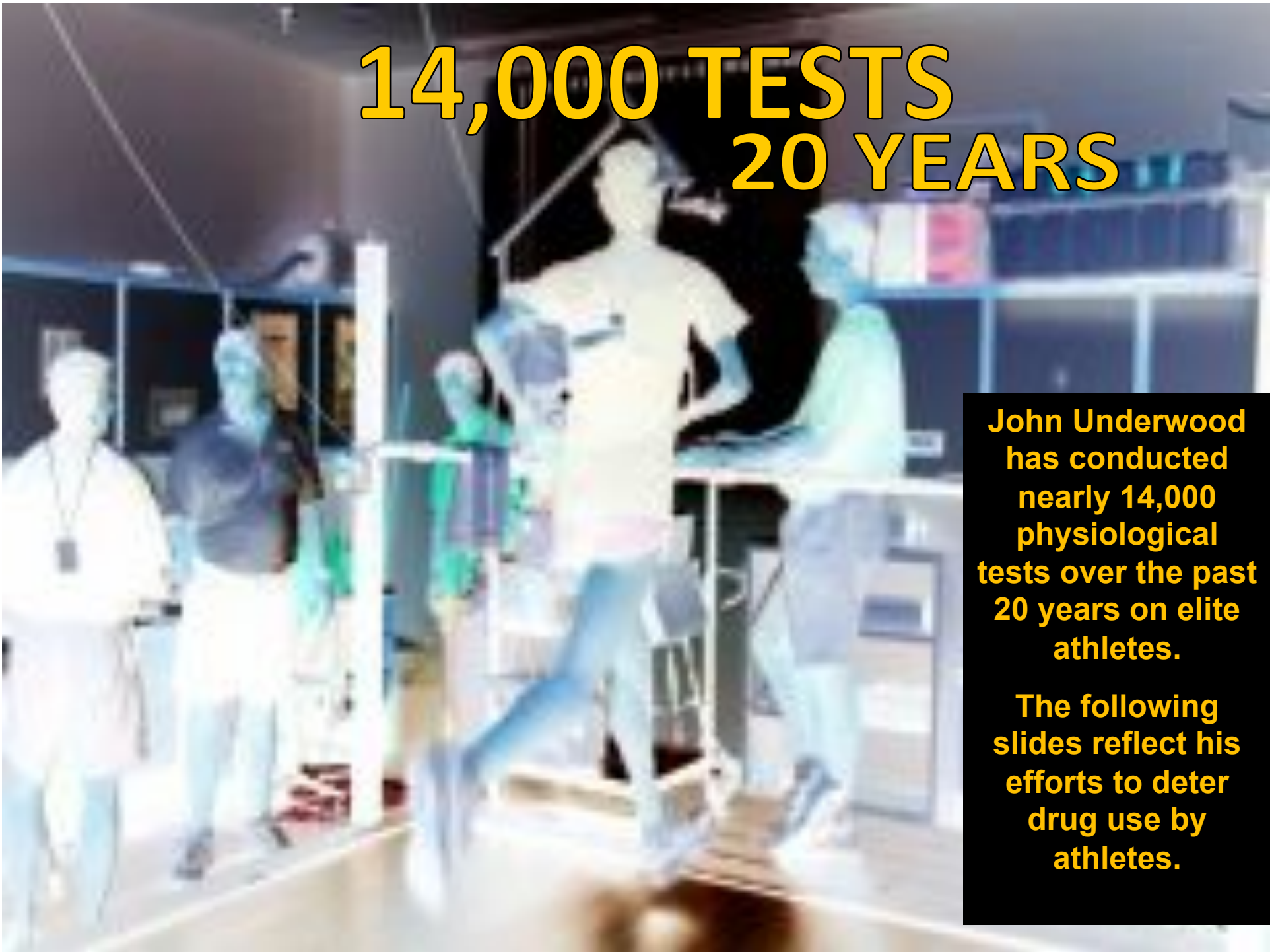


# USOC Lab

Lake Placid, NY



# 14,000 TESTS 20 YEARS



**John Underwood  
has conducted  
nearly 14,000  
physiological  
tests over the past  
20 years on elite  
athletes.**

**The following  
slides reflect his  
efforts to deter  
drug use by  
athletes.**

# 28 OLYMPIANS





**Naval Special Warfare**

# Laboratory Testing



United States Navy SEALs  
Human Performance Project



# RECOVERY

**Physiological Considerations for Recovery in Elite Hockey**

**John Underwood** Director American Athletic Institute

# Understanding Recovery





NCAA College Sport





# CHAMPION ATHLETE PROGRAMS

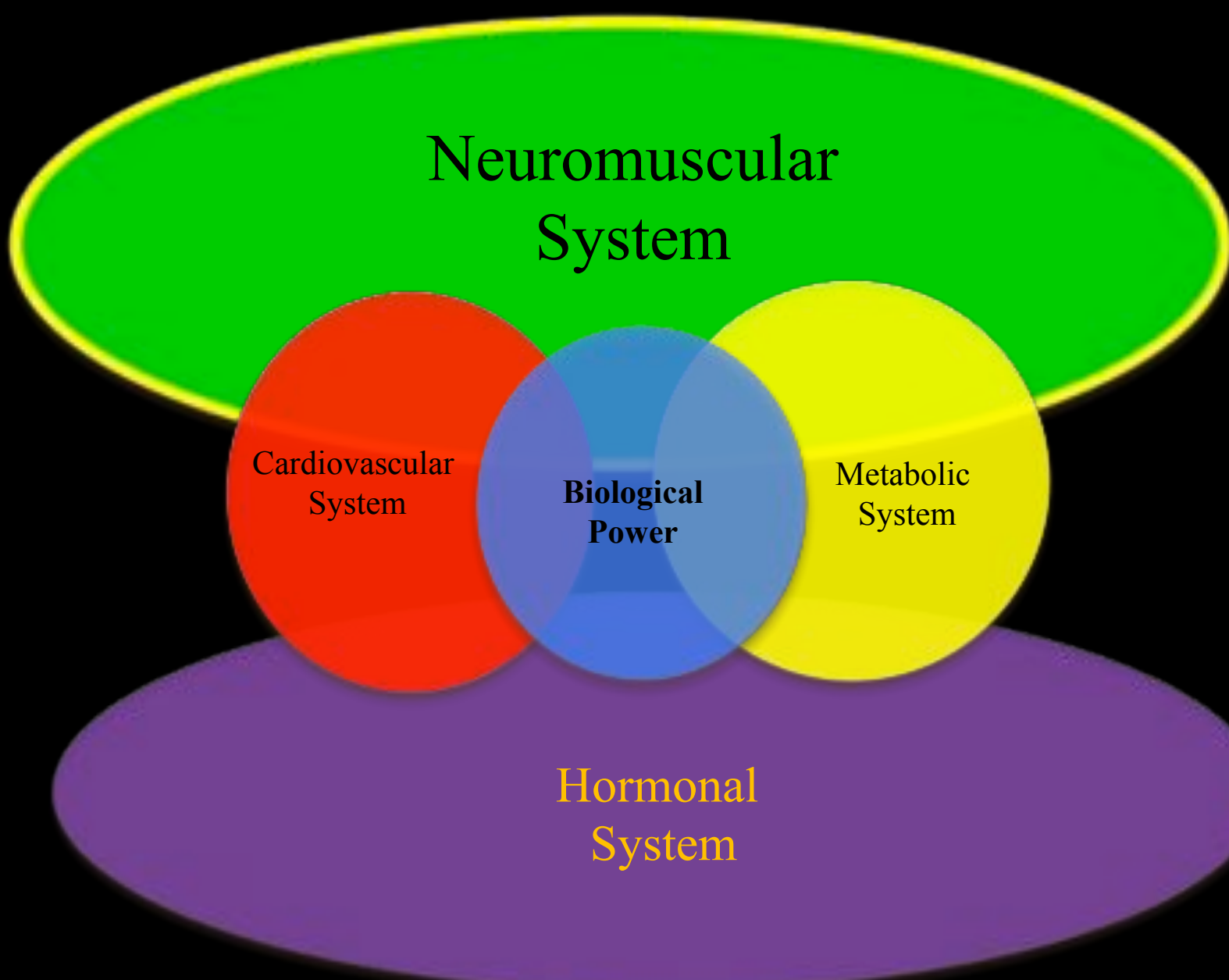


# ATHLETE LIFESTYLE EDUCATIONAL MODULES





Figure 1 - The Gears of Training and Performance (Niggli, 1990).



# Neuromuscular System

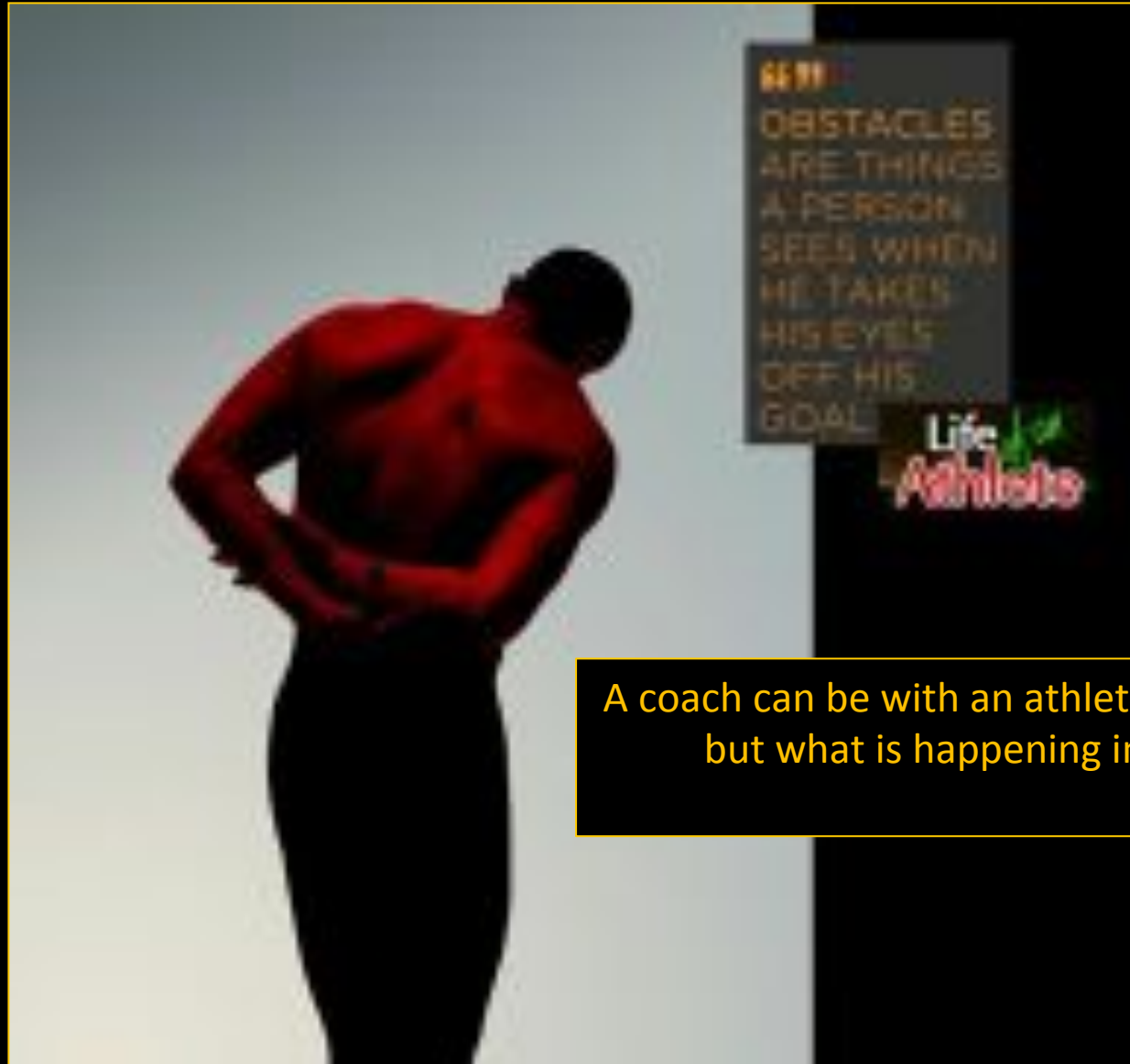
Cardiovascular  
System

**Biological  
Power**

Metabolic  
System

Hormonal  
System

# Lifestyle matters... Lifestyle counts



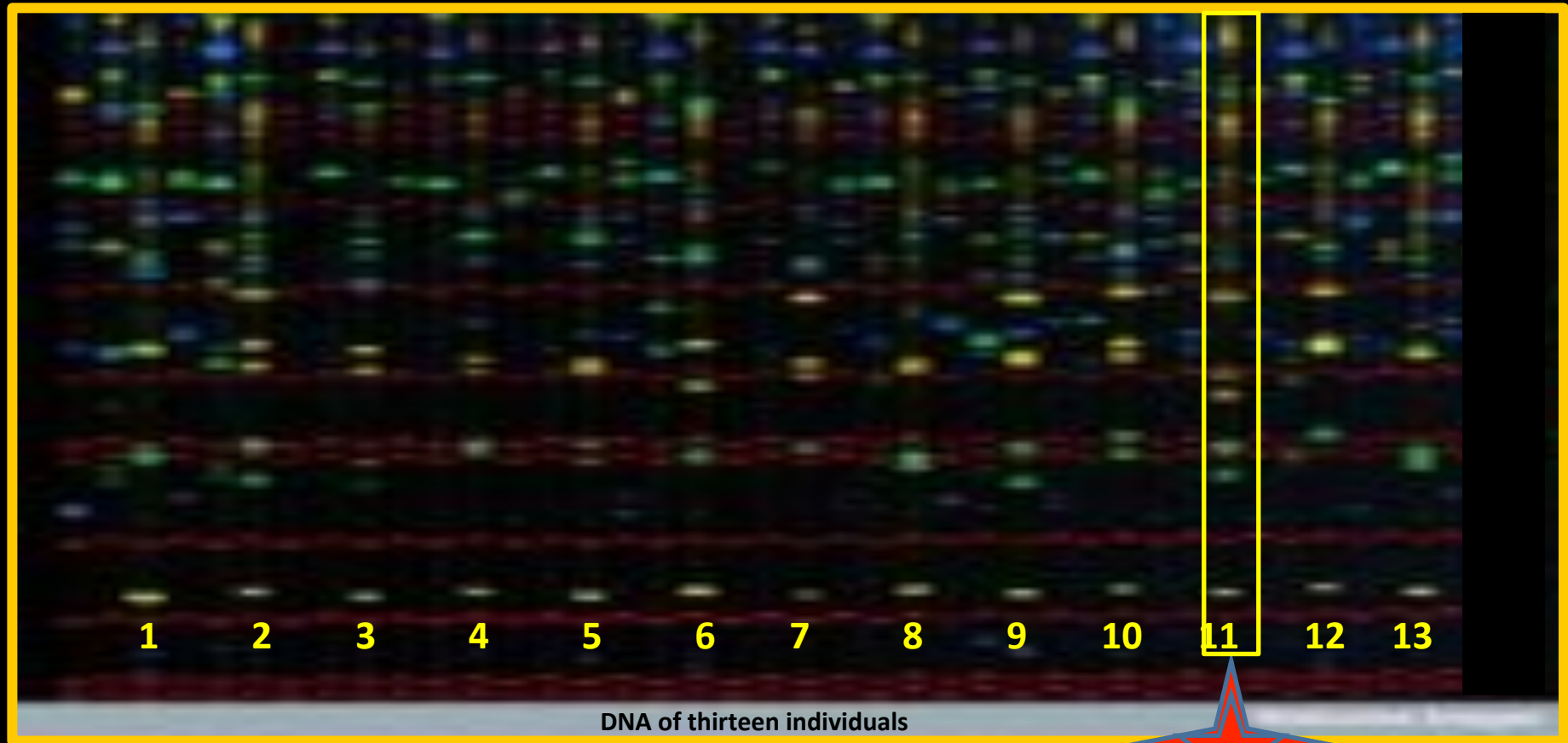
1%

A coach can be with an athlete for three hours in a day...  
but what is happening in the other 21 hours?

Joachim Cruz

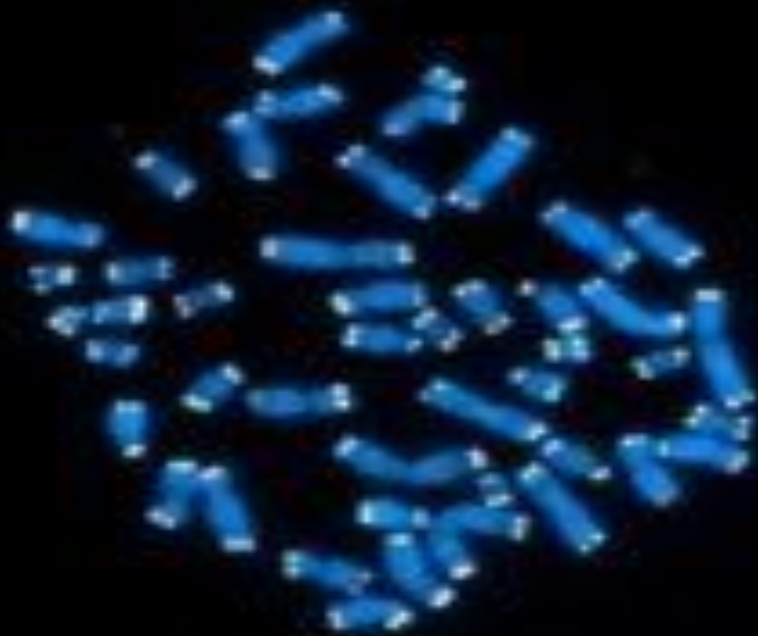


# ALL THAT MAKES YOU



8%

TALENT



## **TALENT**

*Takes you to the crossroad of opportunity... it's the rest of the journey that makes a champion!*

Life *of an*  
**Athlete**

No amount of talent will overcome a lifestyle that is in conflict with elite athletic performance...



# Performance Factors

LIFESTYLE

Inseason



Inseason



TRAINING

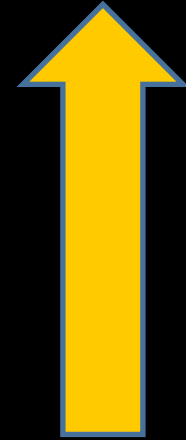
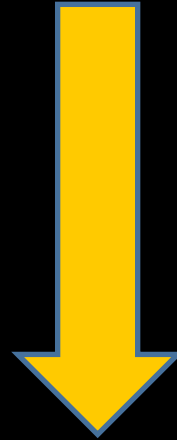


# Peaking Training

A hand holding a red pen is drawing a graph on a piece of paper. The graph has several red lines and points, suggesting a training schedule or performance data. The background is slightly blurred, focusing attention on the drawing process.

100 DAYS

Olympic  
Games



Modernization has affected factors in athlete development which are clearly not conducive to optimal mental and physical performance...

# Training Recovery Performance



# Athlete lifestyle is changing



## Mostly Downward



facebook.

# LIFE AS WE LIVE IT



The lifestyle of this century has created conflicts and dilemmas that greatly reduce the effectiveness of top level athletes to train, recover and perform consistently at or near their best.



6:35  
Time to train



# EDUCATION FOR OLYMPIANS



If we do not teach athletes to live an optimal lifestyle They will still make one up!



**For many there is no rhythm!**

**BIO  
CIRCADIAN**



**RANDOM EVENTS**

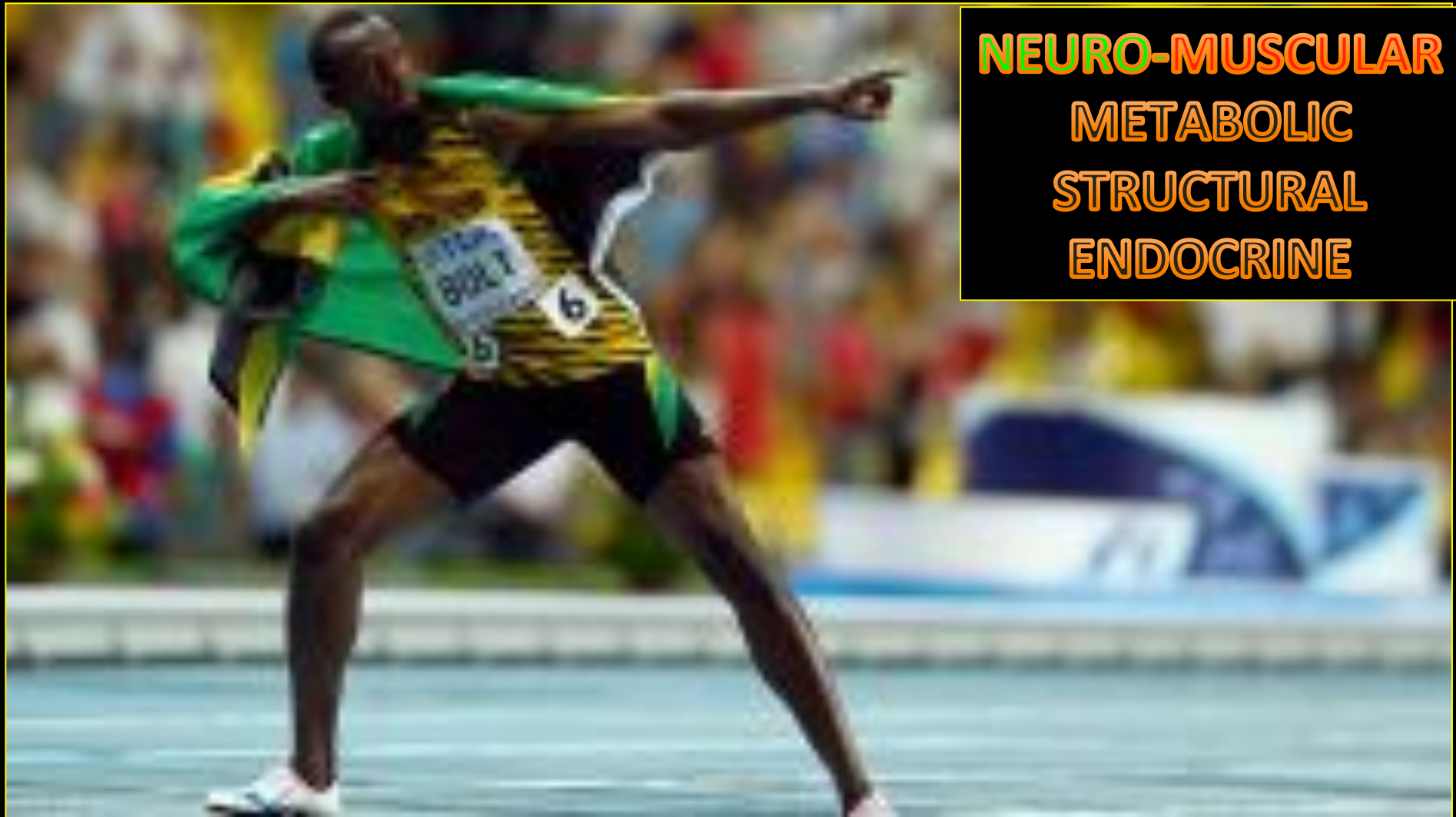
# LIFESTYLE AND RECOVERY



The single most overlooked aspect of athlete failure is issues related to recovery...

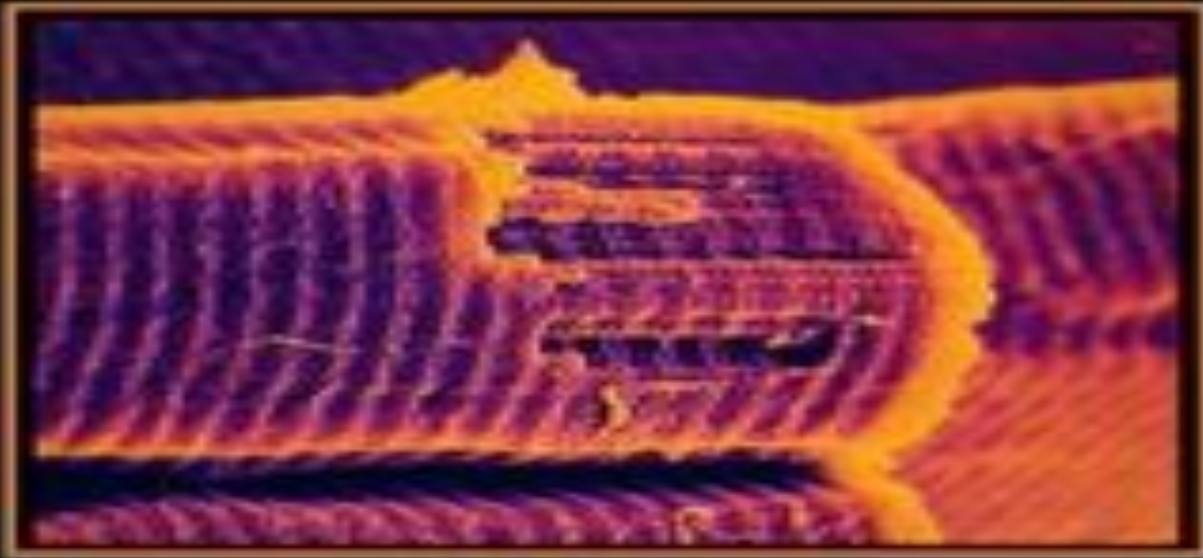


Fatigue, which is at the root of the whole recovery paradigm, can be split into four categories



**NEURO-MUSCULAR**  
**METABOLIC**  
**STRUCTURAL**  
**ENDOCRINE**

# Example Muscle Concerns



WARMDOWN  
NUTRIENTS  
COMPRESSION  
HOT/COLD  
MASSAGE  
ELASTICITY/FLEX

Where has the same consideration  
been for CNS?



The single biggest factor in  
optimal performance

**CNS READINESS**

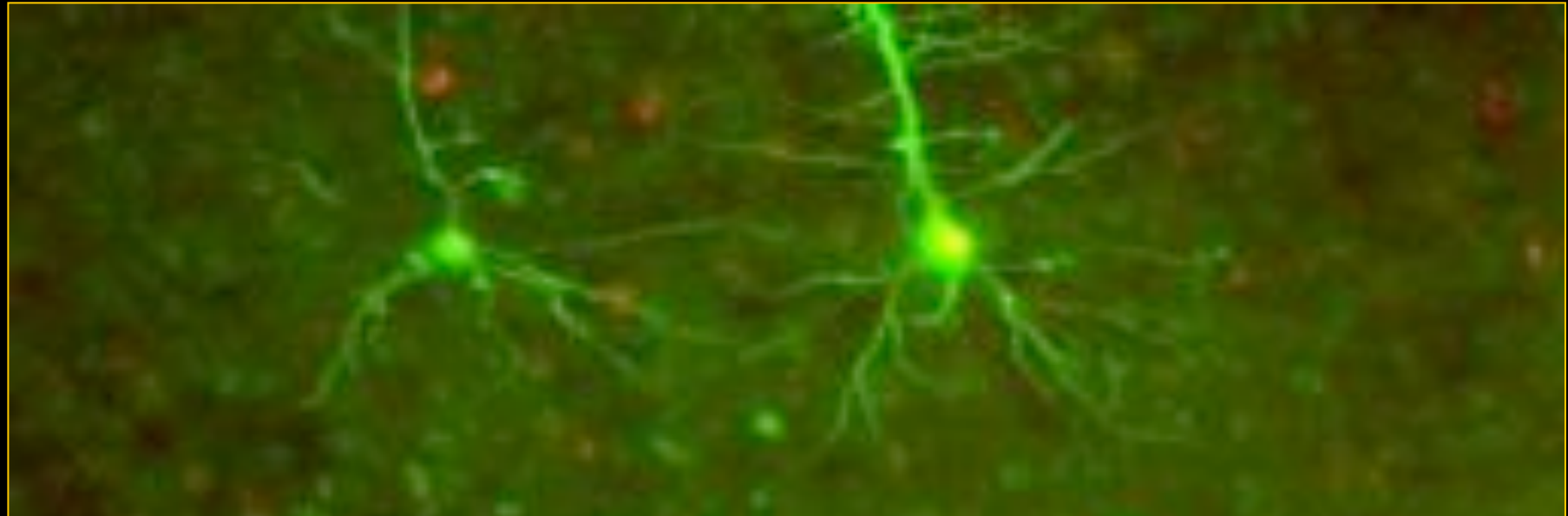


The brain  
processes  
400 billion  
points of data  
every second.

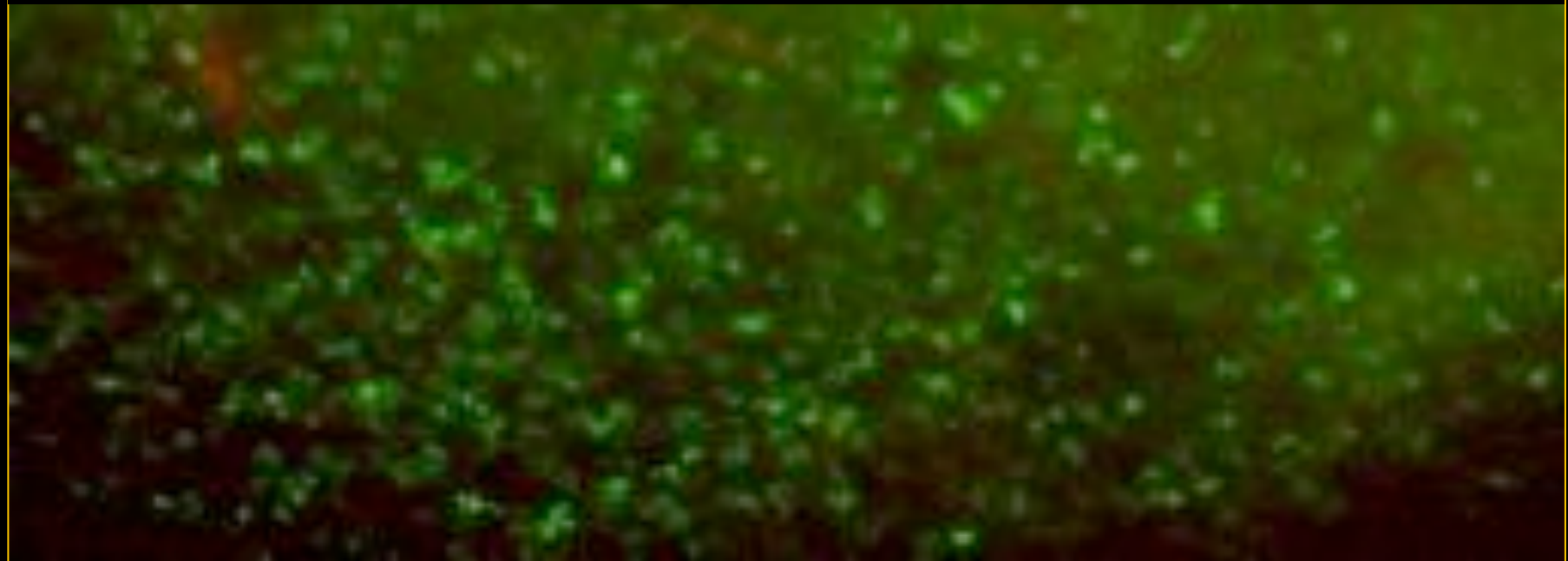
Life of  
Animals

Is your brain ready to play?





100,000 Chemical reactions per second during athletic competition





## Brain Drain

Learn how you can either waste or save CNS readiness for when you need it in a competition...





# SLEEP

The effect of sleep on high level mental and physical performance



# STRESS

The effect of stress on high level mental and physical performance



# SOCIAL DRUGS

The effect of social drugs on high level mental and physical performance



# HighSchool TODAY

New Mexico's  
'Life of an Athlete'  
Wannabe? Watch Out!



## Legal Issues

Proper documentation  
to school sports programs

## Athletic Facilities

Safe, secure, and  
well-maintained

## Sports Medicine

Proper training, diet,  
hydration, and  
rest

## Lifestyle Strikes Back



Sleep  
Now Clearly a Predictor  
of Performance

W



"The problems of overtraining are  
for athletes of any age or level  
of sport is a real problem.  
It is a real problem and a real problem for  
the young."



## coaches PLAN coaches

Athletes and social drug use...

THE  
PARTY  
is OVER

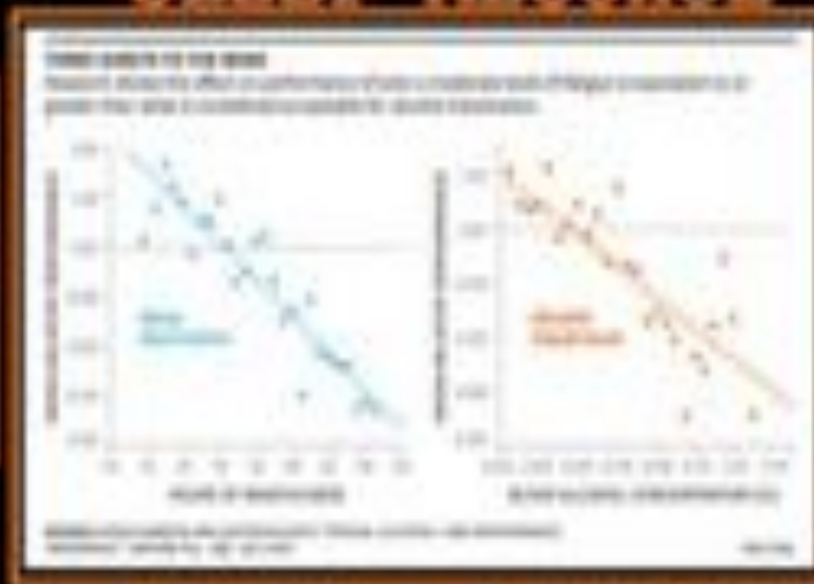
There is a growing concern among coaches and parents about the use of drugs and alcohol by athletes. This is a real problem and a real problem for the young. The problems of overtraining are for athletes of any age or level of sport is a real problem. It is a real problem and a real problem for the young. The problems of overtraining are for athletes of any age or level of sport is a real problem. It is a real problem and a real problem for the young.

# AWARENESS





# SLEEP ALCOHOL



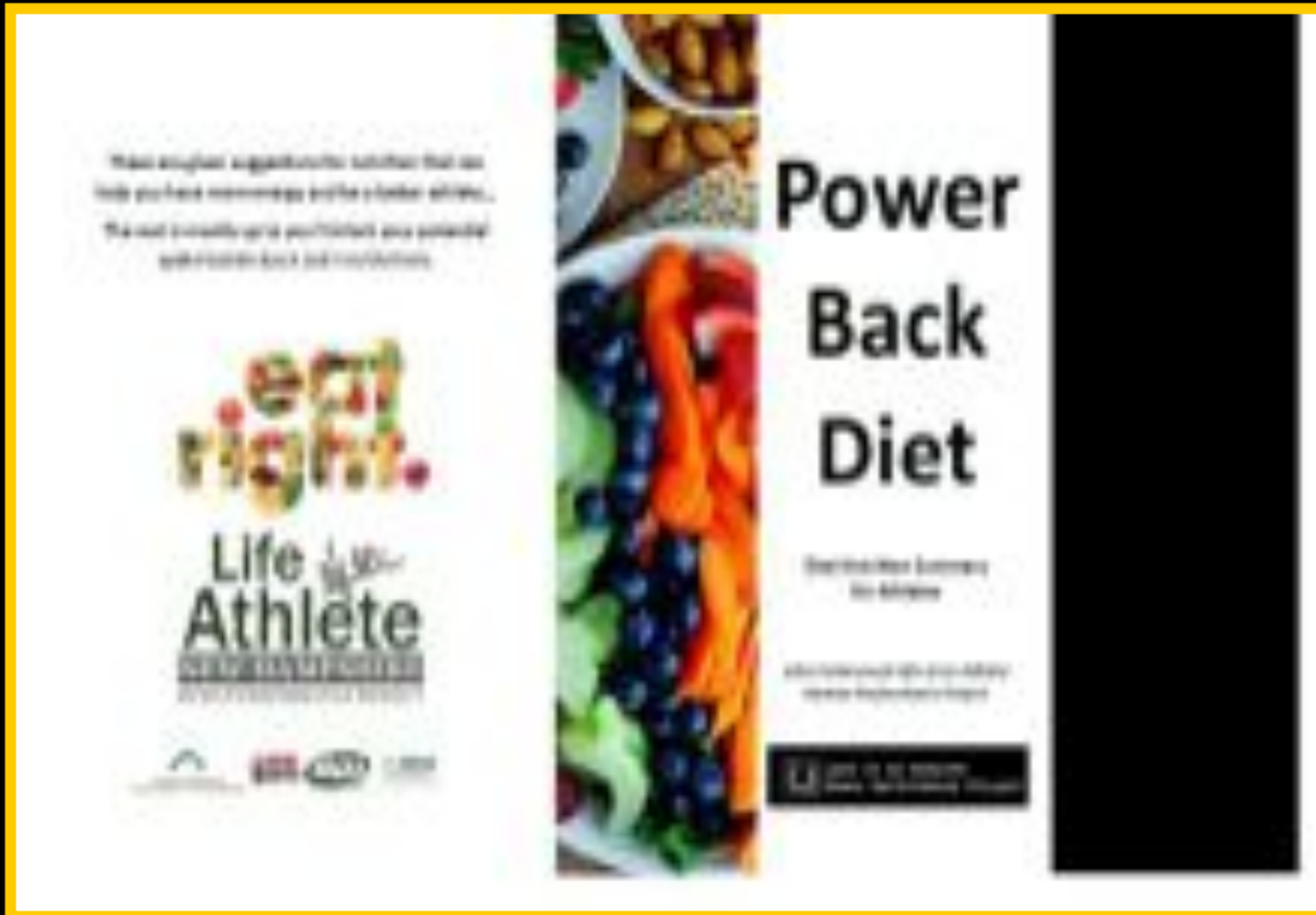
lack of sleep  
and decreased  
performance

alcohol impairment  
and decreased  
performance

Now the similarity of decreased performance from sleep and to alcohol. It shows a sharp identical profile for performance that is clearly diminished. Athletes need to understand how much you lose when you don't sleep or booze!



# Nutrition





Worse than we thought!

160,000 fast-food restaurants strewn  
across the U.S., serving approximately  
50 million people each and every day.

35% of the U.S. population considered obese



Life of an Athlete  
Human Performance Project

Life of an Athlete

FOOD CHOICE DETERMINES ENERGY LEVELS

# SOCIAL ISSUES 2013



**STRESS**  
**TIME MANAGEMENT**  
**SLEEP/CNS FATIGUE**  
**RECOVERY**  
**DIET/NUTRITION**  
**ADVANCED**  
**TECHNOLOGY**  
**SOCIAL DRUG USE**  
**PRESCRIPTION DRUG USE**  
**SUPPLEMENTS**



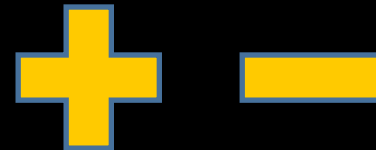
It's not just what you are willing to give...  
It's what you are willing to give up!



# PERFORMANCE FACTORS



In sport we spend most of  
our time looking at  
positives and ignore to a  
great extent the negatives...





Blood glucose up  
Muscles Fueled  
Hydrated  
Body systems rested  
CNS rested  
Hormones up



**FACTORS**

**ALL SYSTEMS GO**





Poor Diet  
Poor Sleep  
Stress  
CNS Overstimulation  
Social Drug Use  
Poor Recovery  
Poor Training Methods

— FACTORS

ALL SYSTEMS NO





24 HOURS

BODY RECOVERY



# BODY MUST BE RESTED WHEN YOU TRAIN

The CNS takes much longer to recover than the heart lungs and muscle systems...

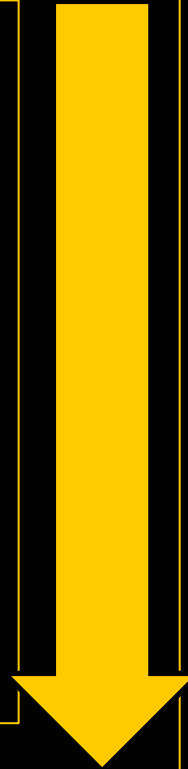
48 HOURS

24 HOURS



# RECOVERY

HOUR 1  
HOUR 8  
HOUR 24



70%  
20%  
10%

DYNAMICS OF RECOVERY AND TIME



60  
MINUTES

## The first hour

During the first hour after a workout the majority of recovery takes place and training effect is maximized.





The single most critical factor in training effect taking place or not...

# POST TRAINING NUTRITIONAL RECOVERY





The highest rates of nutrient uptake occur during the first 10mins after training .



This is because all the nutrient transport and storage mechanisms become switched on thus increasing the body's absorption rates. The nutrients that are required are glucose (from Carbohydrate) and amino acids (from Proteins).

**THE QUICKER THE BETTER**





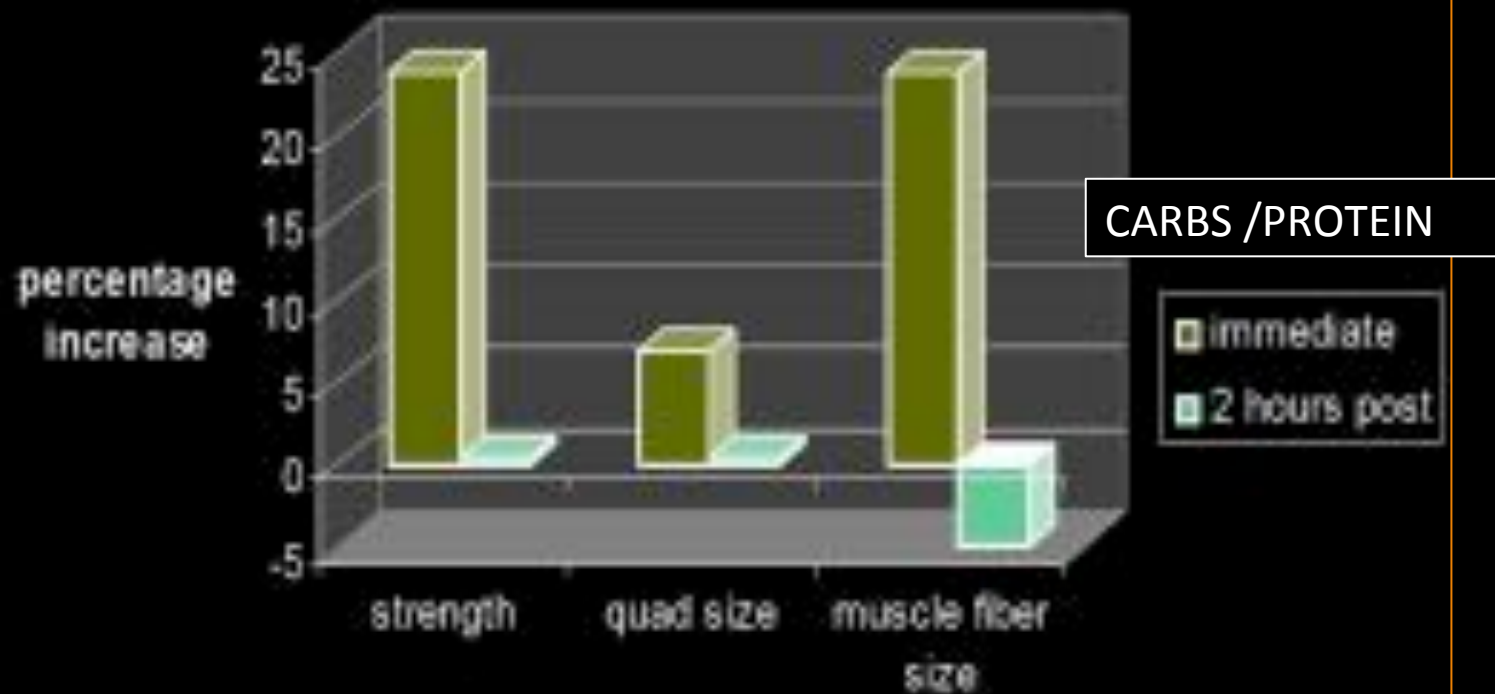
# PROTEIN

Protein blunts negative effects  
Accelerates positive factors in muscle

**Fast Protein Critical**



## Changes in strength, muscle size, and muscle fiber size



# Don't Wait



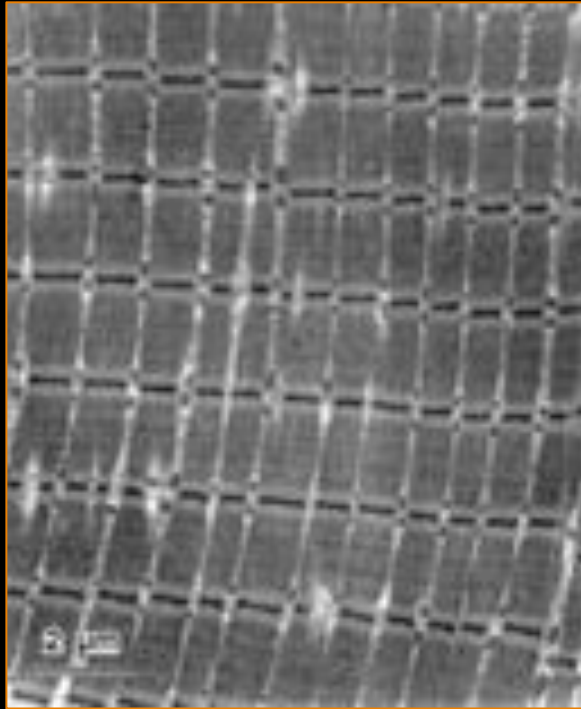


There is muscle damage from any kind of physical activity

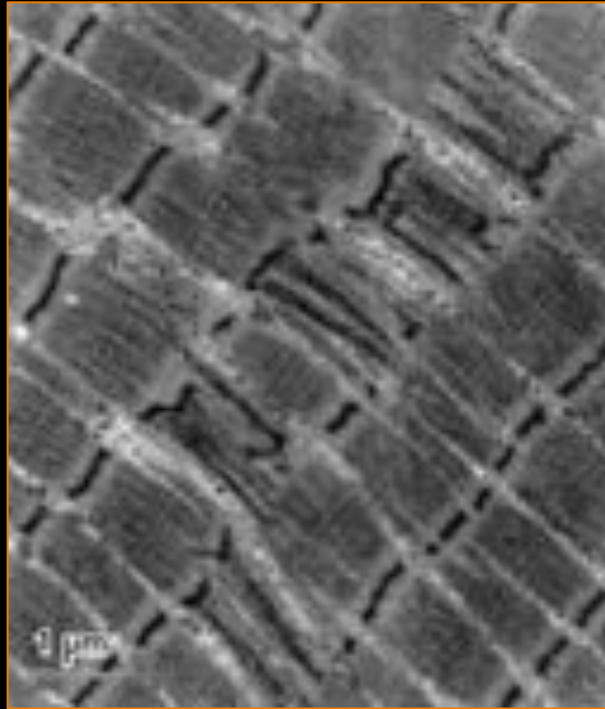
The higher the intensity the greater the damage

**MUSCLE DAMAGE**





NORMAL



MODERATE

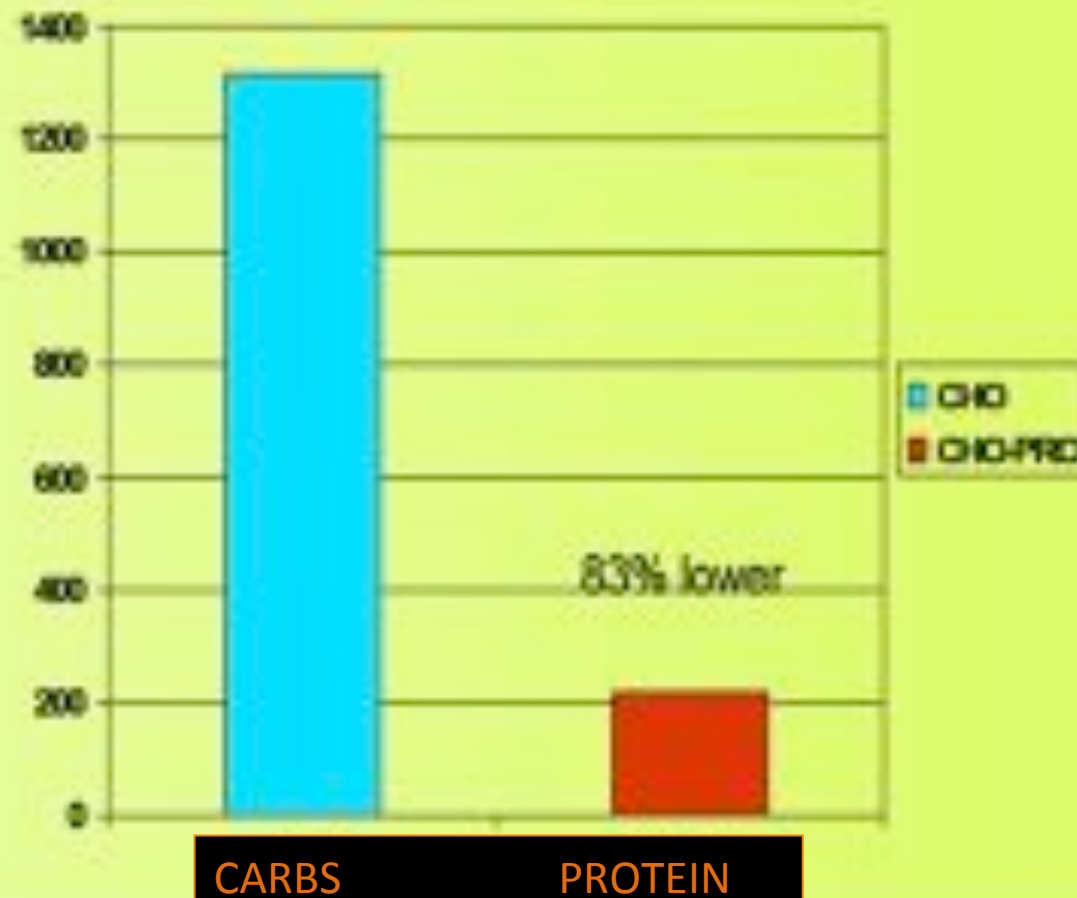


EXTREME

# Muscle Damage



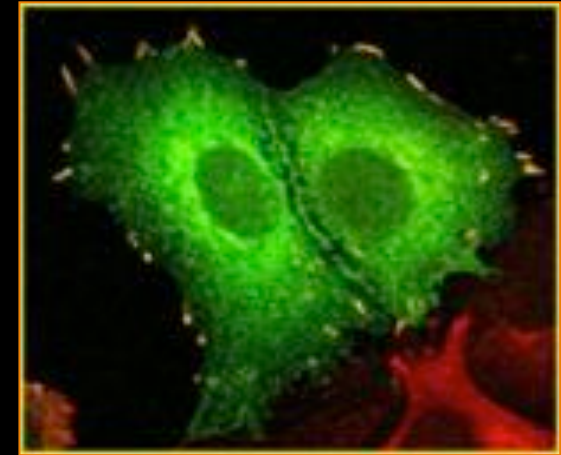
## CARBS AND PROTEIN AFFECT ON MUSCLE DAMAGE



How sore do you want to be?



## Muscle Fiber Hypertrophy in Protein Group

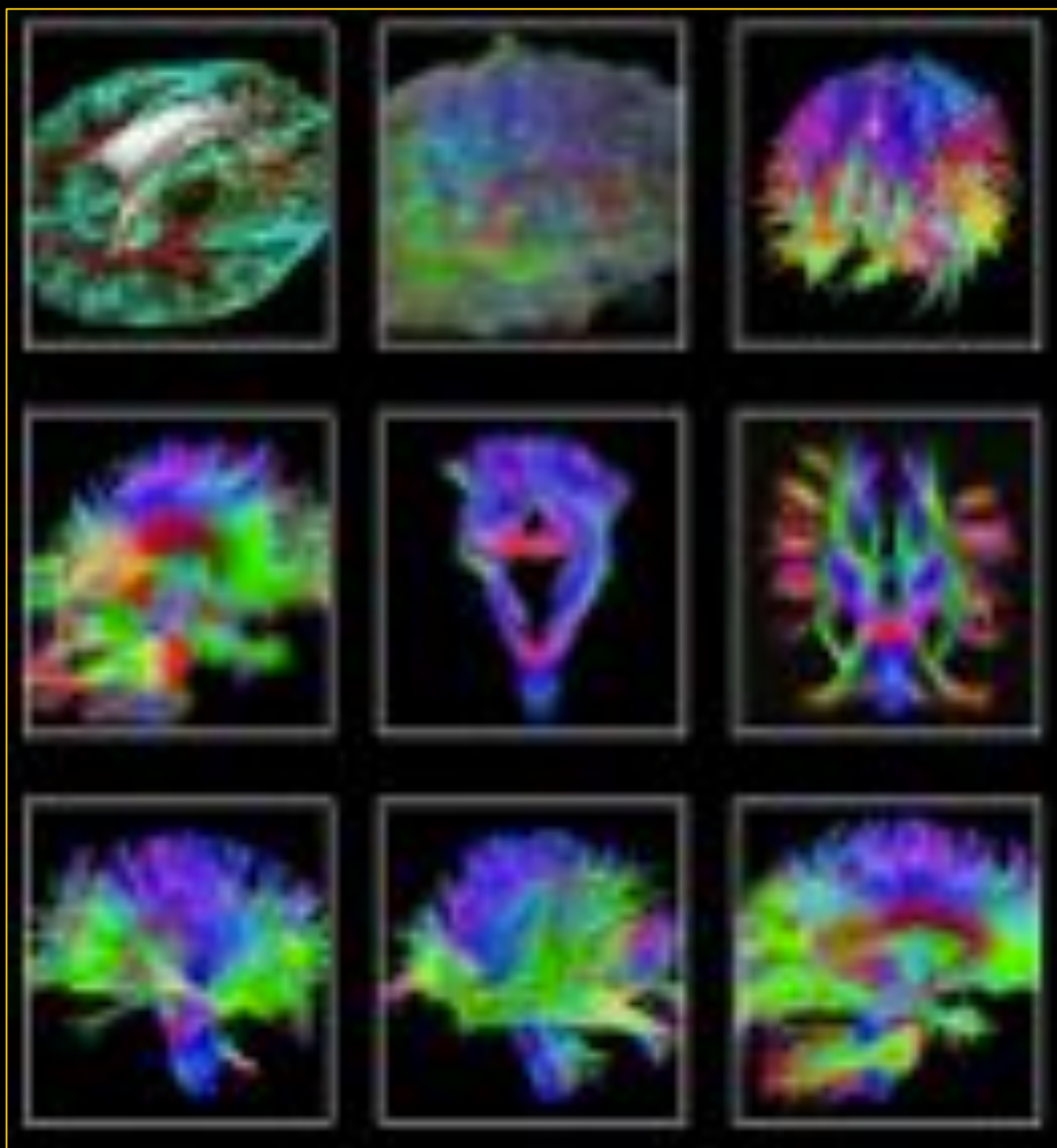


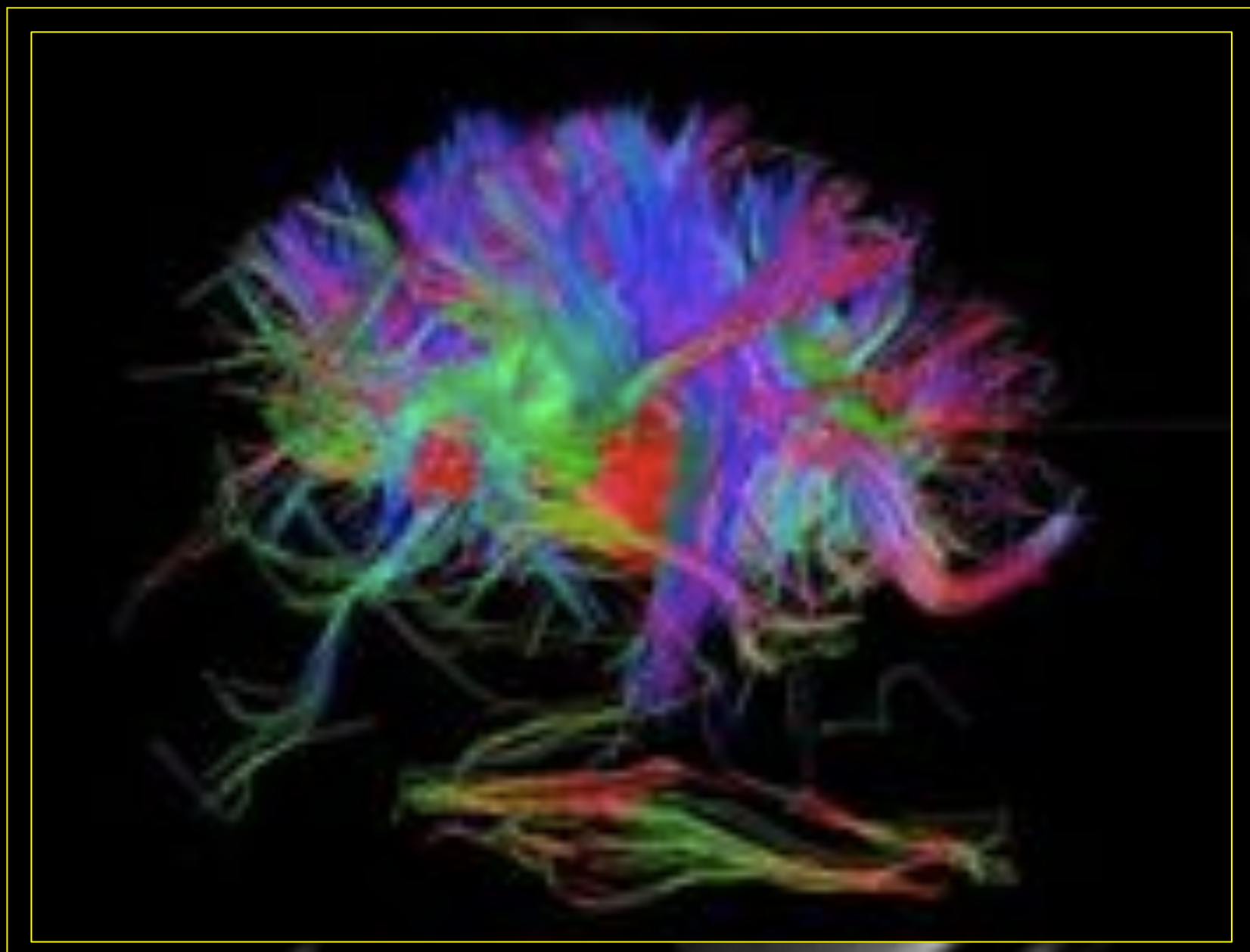
**NEW  
MASS**

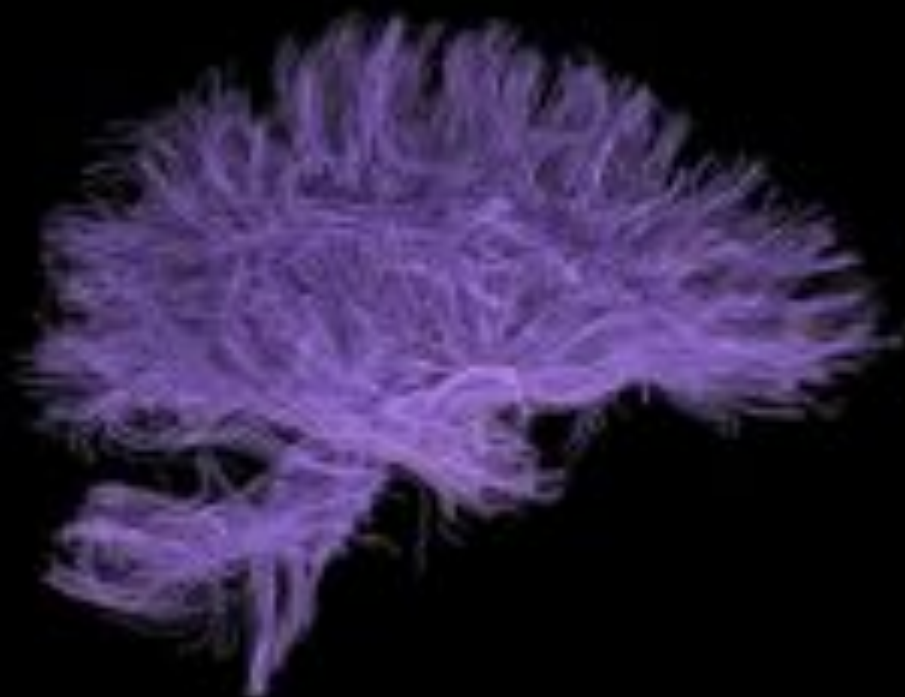
**Muscle Protein Synthesis**







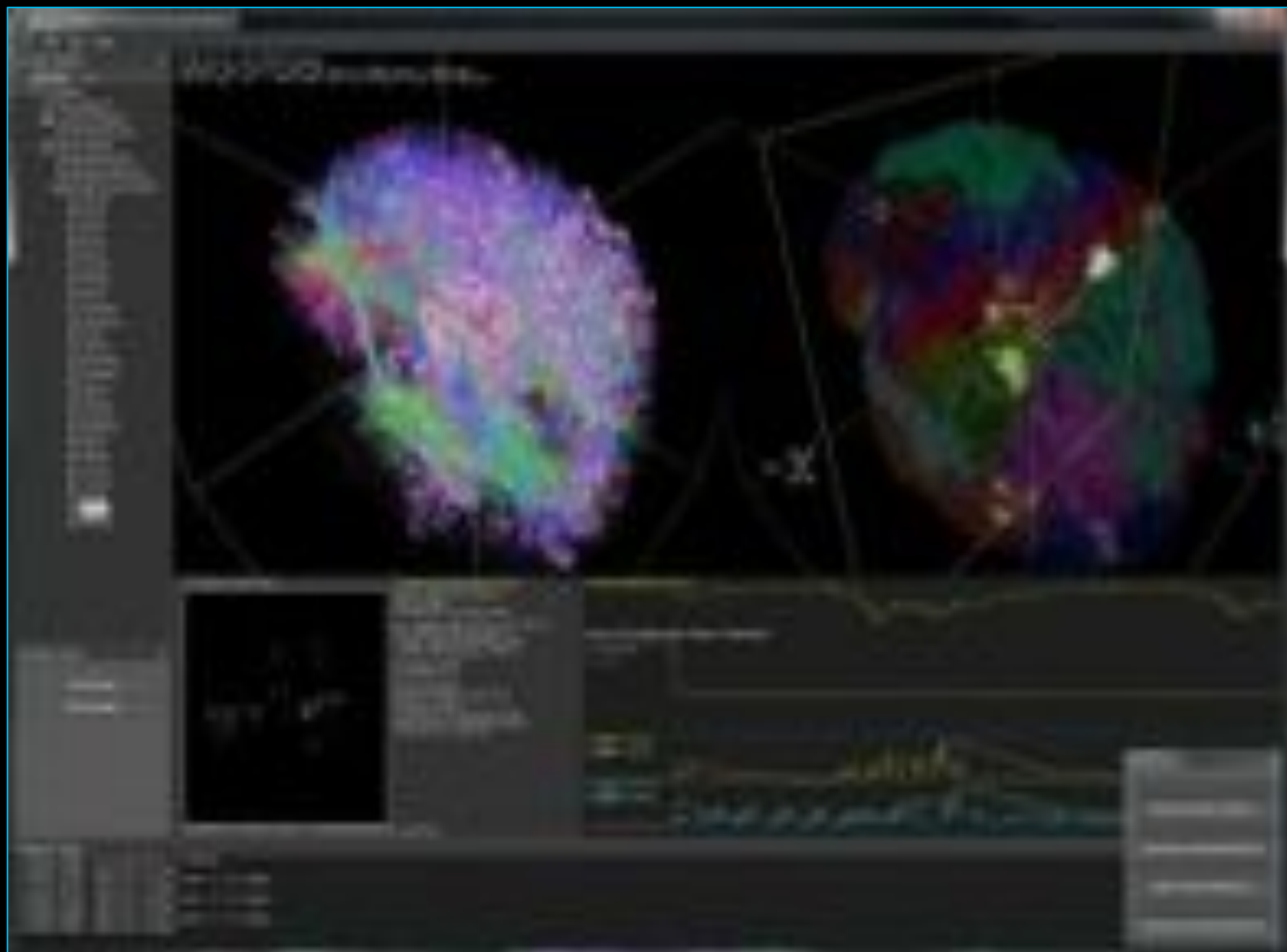






The total surface area of 100 billion neurons is equivalent to four (4) full size football fields.



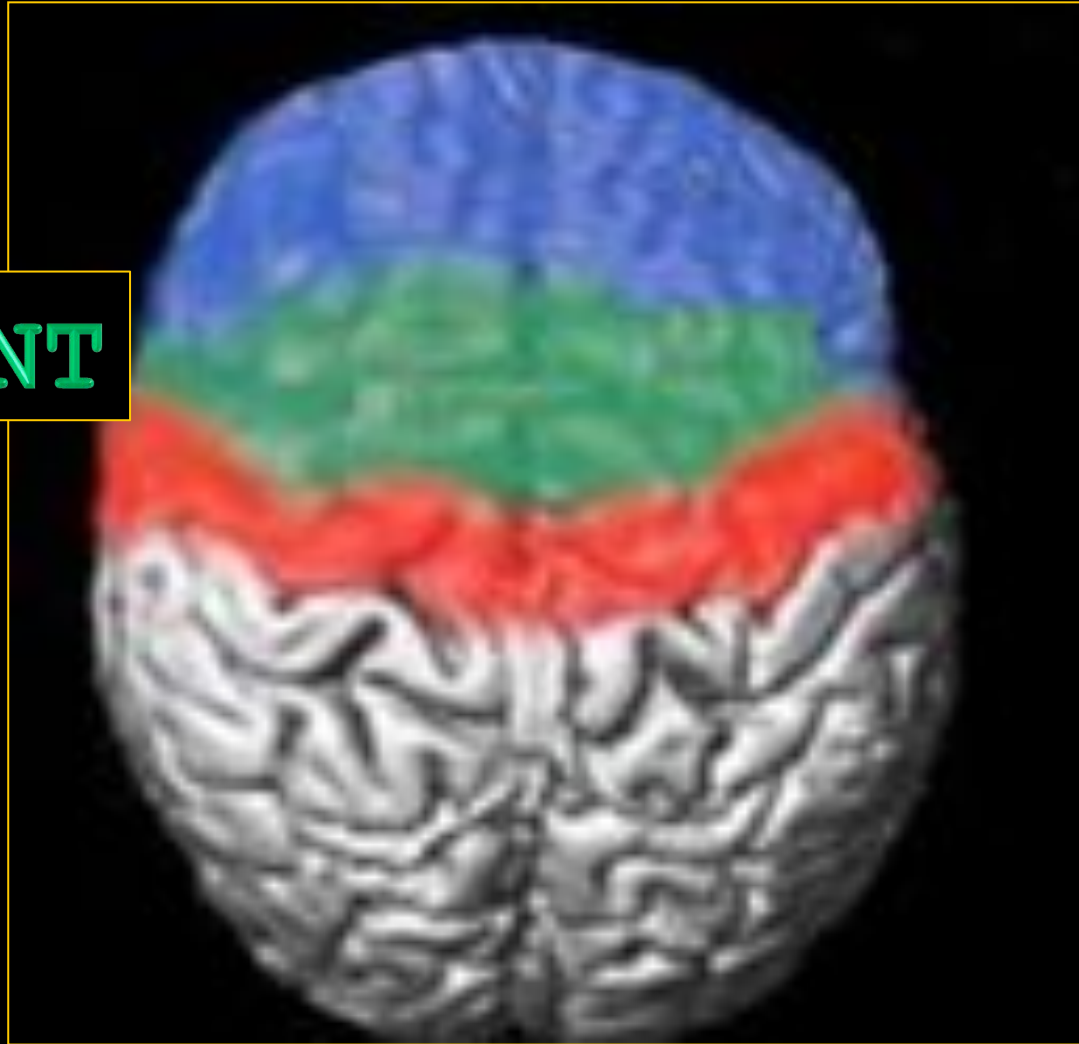


**Play Video Clip**

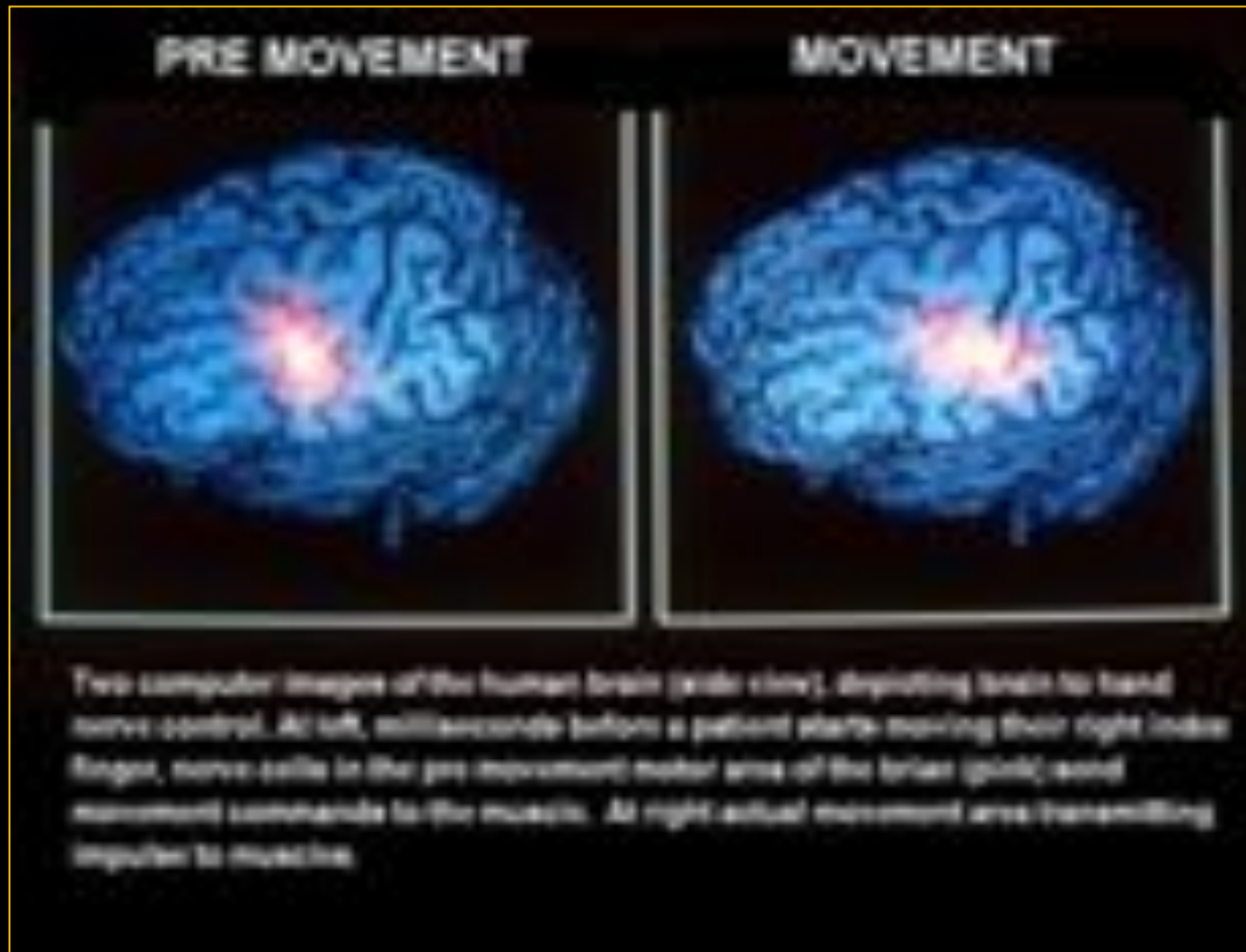
THINKING

PRE-MOVEMENT

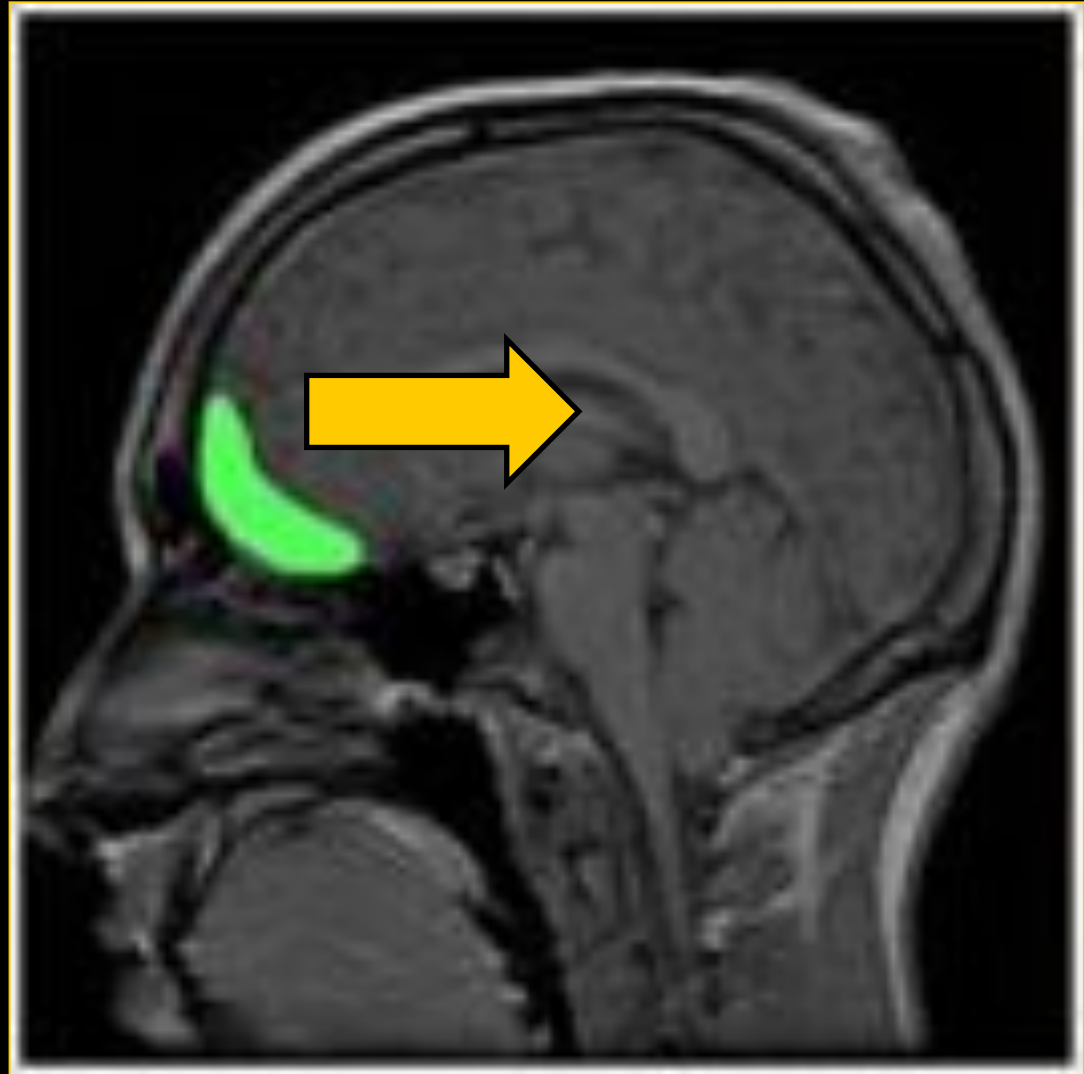
MOVEMENT



Brain and Movement

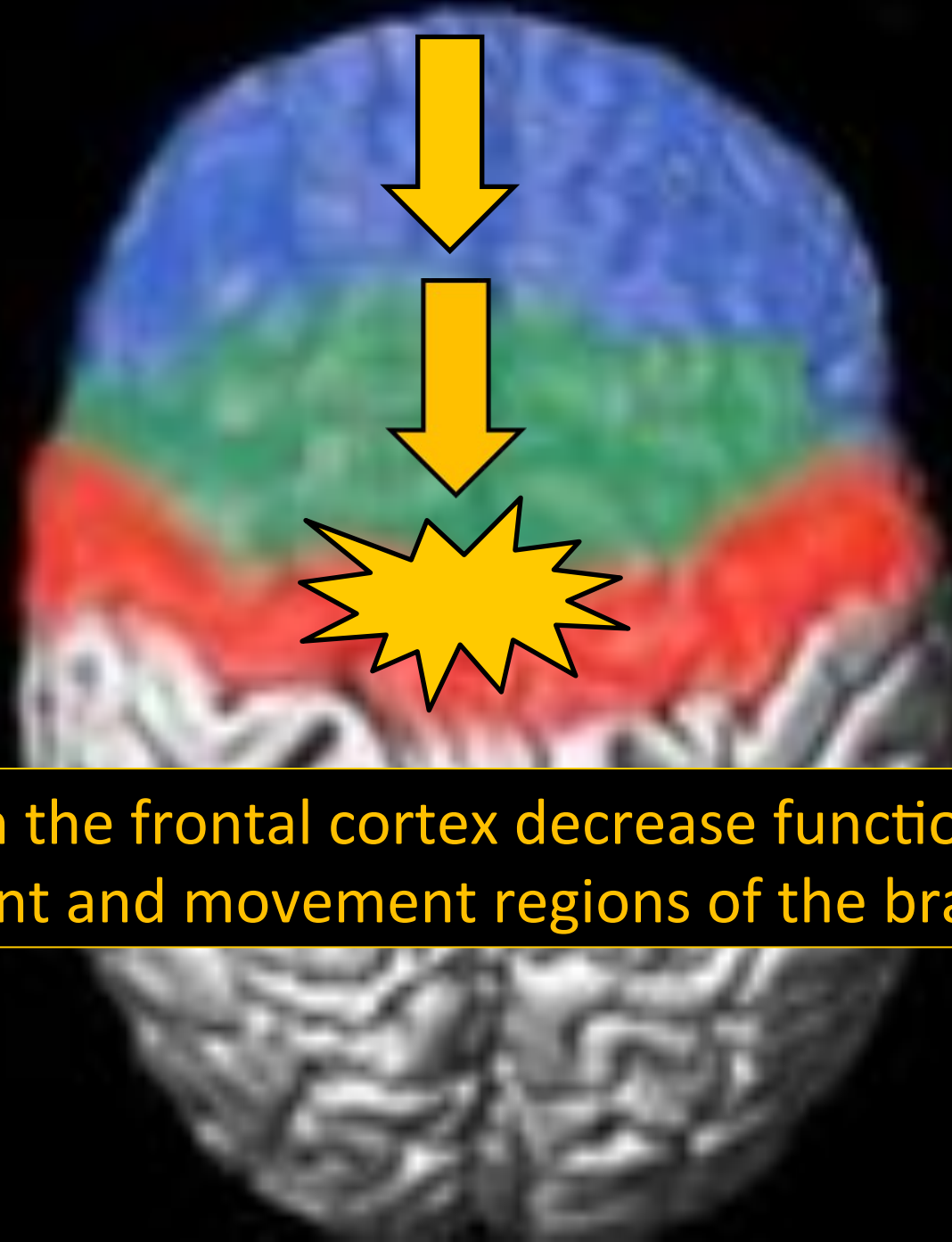


# Physical Movements



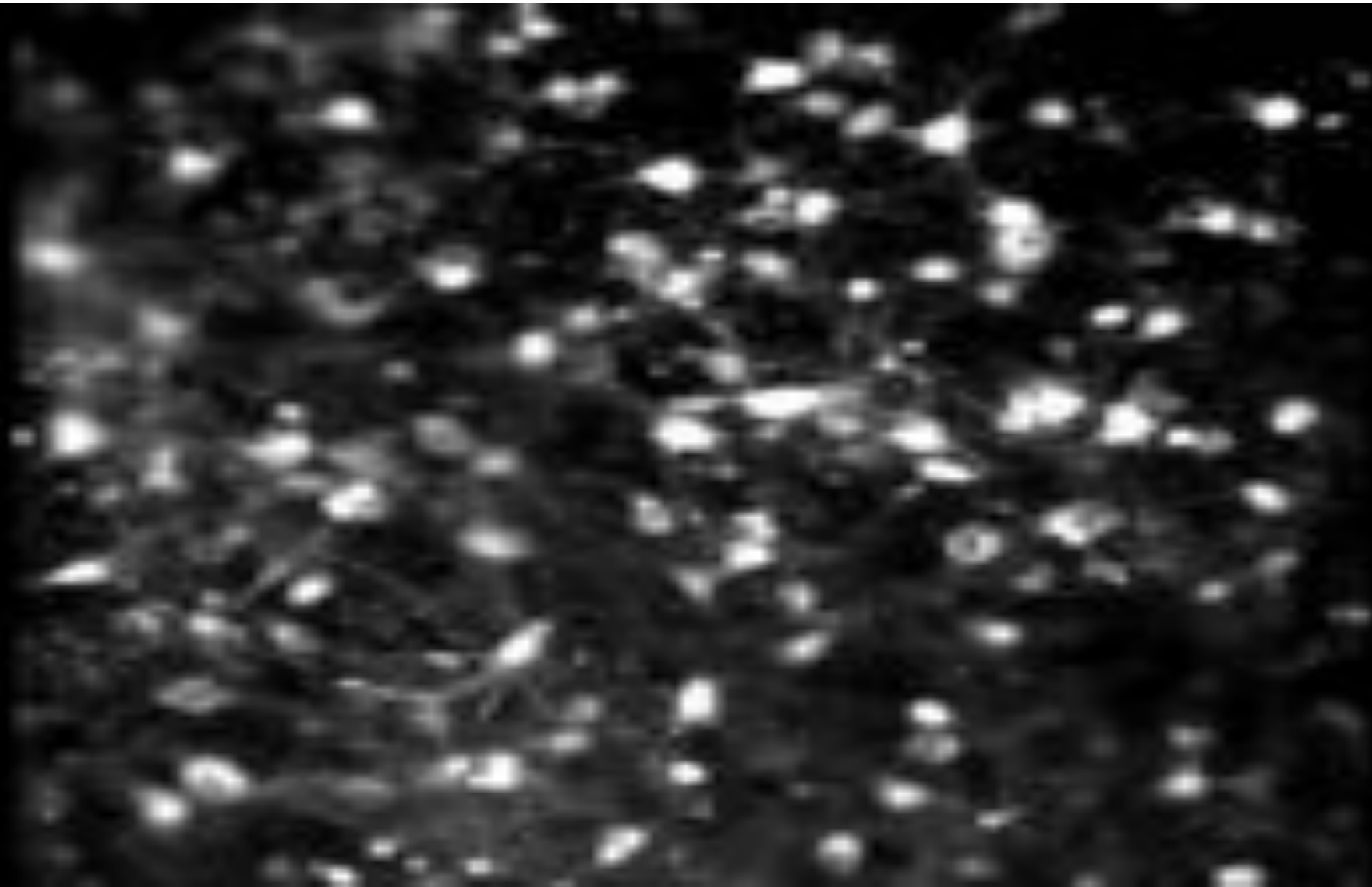
Neural fatigue in processing (FRONTAL CORTEX)  
fatigues other regions of brain function...





Fatigue levels in the frontal cortex decrease functions in pre-movement and movement regions of the brain





*Neuronal activity during physical activity*

**FIRESTORM**



The amount of  
information we are now  
exposed to has increased  
more in the last 50 years  
than in the previous  
5,000.

*"Every piece of information you are consciously  
or unconsciously exposed to - has to be  
processed by your brain!"*

# Information Overload

## Athletes included!



How much does technology effect mental and physical performance?

More than you think!



Life of an Athlete  
Human Performance Project

# PROCESSING

4 years  
1460 days  
35,040 hours

# OLYMPIC TIME

Time management

Every day matters  
Every day counts



The single largest factor in  
athletic development is time... Matveev USSR





**Everyone gets 24 hours ...  
its how you use them that matters**

**The human body can adapt to less time  
but there are serious deficits in mental  
and physical performance...**



# ATHLETE TIME

1-3 WORKOUTS PER DAY

4-6 HOURS BETWEEN WORKOUTS

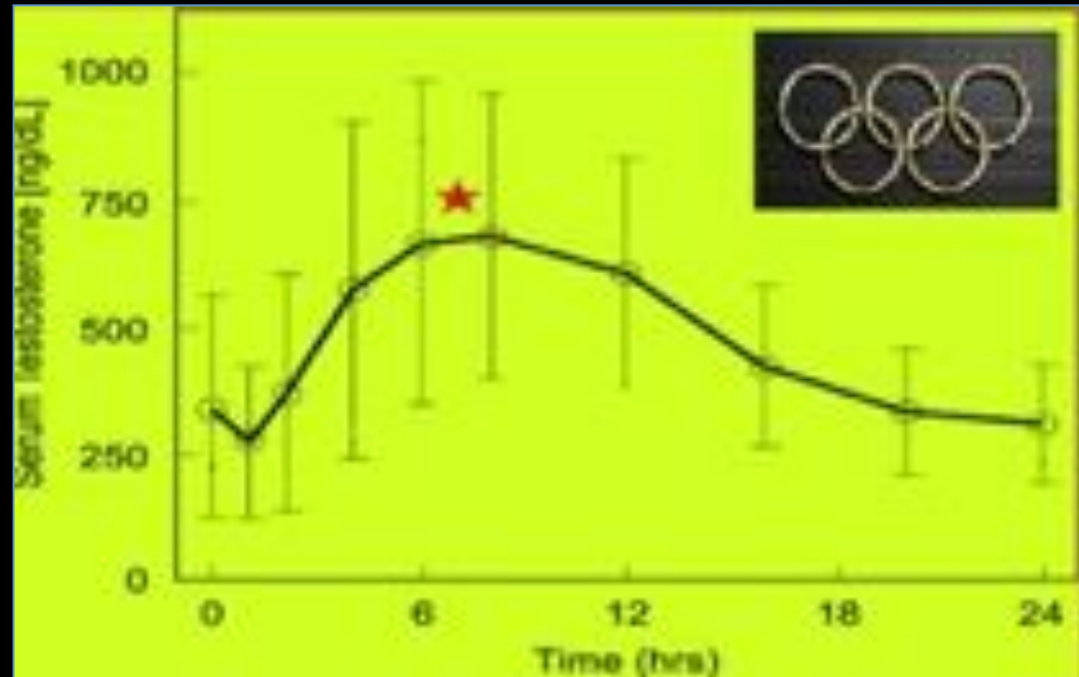
24 HOURS FOR FULL RECOVERY

1 HOUR MAX FOR HIGH INTENSITY



It is now necessary to monitor athlete time management with them and for them due to the societal influences that are affecting development.





We know training , training effect and recovery are optimal early in day...



**WORKOUT IN  
THE MORNING**  
BEFORE YOUR BRAIN FIGURES  
OUT WHAT YOU'RE DOING

**Fatigued  
Forget it**

The body and all physiological systems must be rested and restored in order for training effect to take place. Any disruptions to the recovery process leaves the body unable to respond anabolically. The net outcome is at best a flatline. Come ready to train....

**DON'T WASTE YOUR TIME**





# OPTIMAL?

Morning training is only effective when athletes are rested...

We know fatigue levels are very high in morning due to many factors...





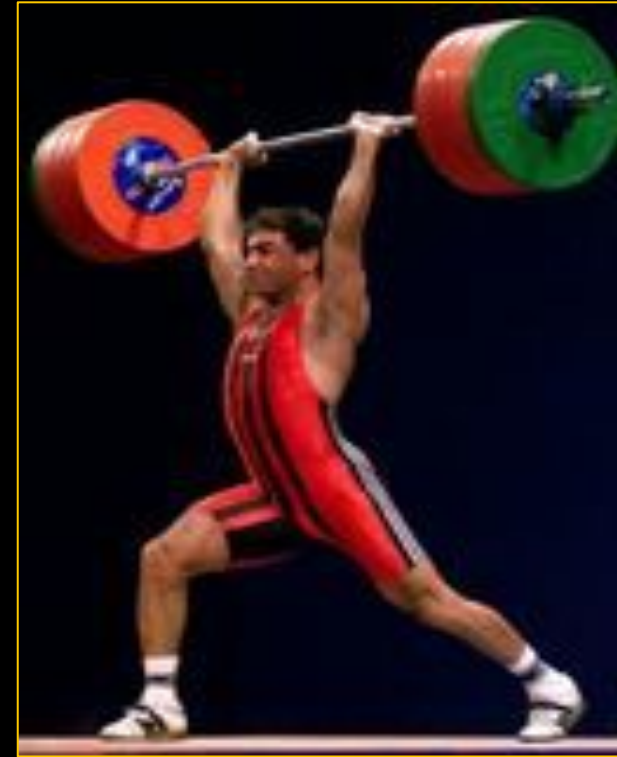
**HORMONE RELEASE**  
**HEARTRATE**  
**EFFICIENCY**  
**MUSCLE FUNCTION**

Neural Fatigue (NF) is defined as an  
involuntary reduction in voluntary activation.





**1-3 days**



The brain seems to be able to build up energy deficits or energy reserves over several days and will function at that level.

**CNS READINESS**



**If you go too hard on your easy days ...  
Soon you will be going too easy on your hard days.**

# **QUALITY RESTED**

**If you are going to train very hard...  
Of course you need to rest very hard.**

**Keijo Hakkinen FIN  
( World's Leading Power Strength  
Scientist)**



# The whole brain and CNS must be rested





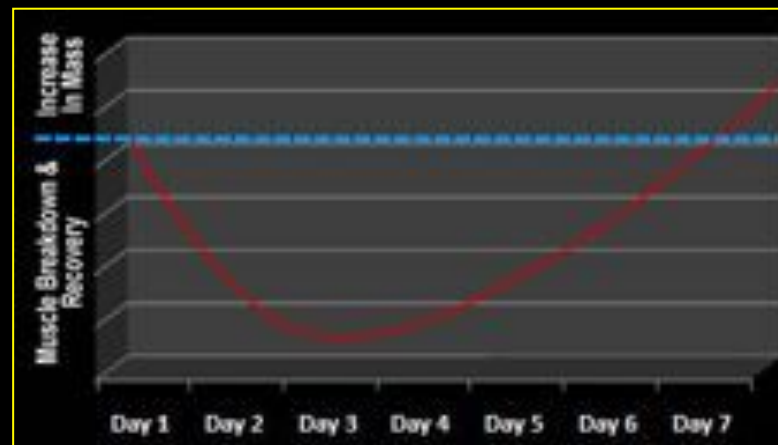


## Neural Fatigue NF

The inability to attain training loads or subpar performance is experienced regularly by elite athletes. It is common for athletes and coaches to have quality workouts that must be postponed or cut short due to fatigue, soreness or the inability to attain desired workloads.

Scientific recommendations have centered in recent years on recovery methods (reactive) and minimizing training damage (reactive)

# RECOVERY MINIMIZE DAMAGE



Attempts to prevent rather than treat conditions or decreased performance potential related to NF.

# PROACTIVE CONSIDERATIONS





**The approach of simply hoping for the adaptation of high intensity capacities to build up an athlete's tolerance to NF is no different than an athlete getting use to sleeping less and less while having to train and compete, tired, at world class levels.**

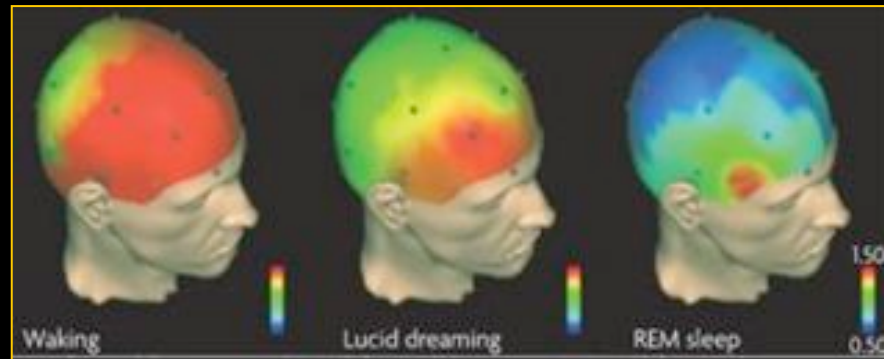


COACH



## Change of plans

Is neural fatigue (NF) taken into consideration in the planning of training or do we just react to these negative issues when decreased performance outcomes are visible in training and or competition results?



**What lifestyle issues affecting are our athletes?**  
**What are the causes?**  
**How can we limit/minimize them?**



PHYSICAL  
PSYCHO-SOCIAL  
EMOTIONAL  
CNS

ATHLETE STRESS

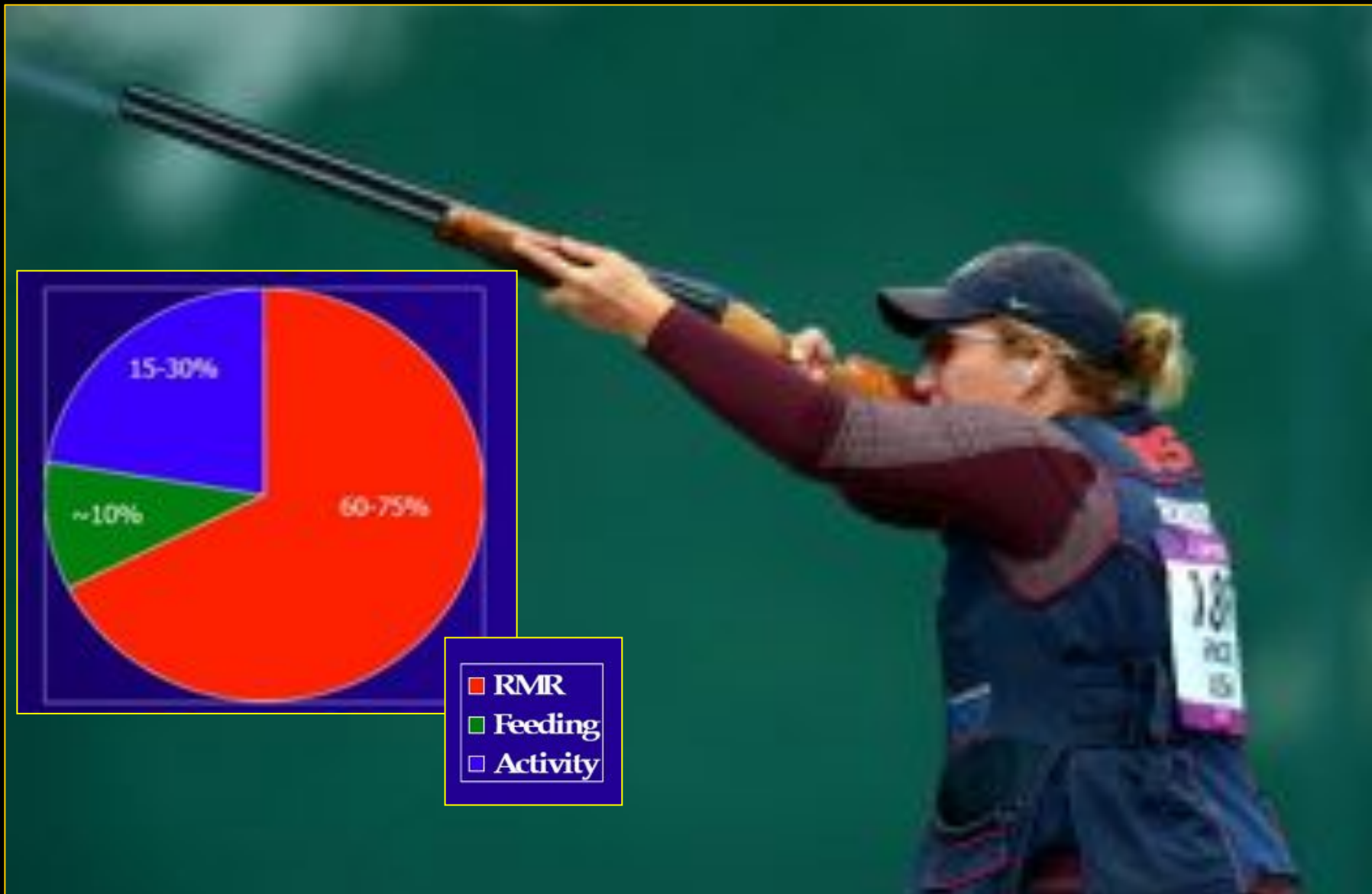


# Many athletes create stress!

Just from a hormonal standpoint testosterone and cortisol indicate that stress destroys much of the training stimulus and recovery that results in adaptation...

Daily activity  
yields stress!



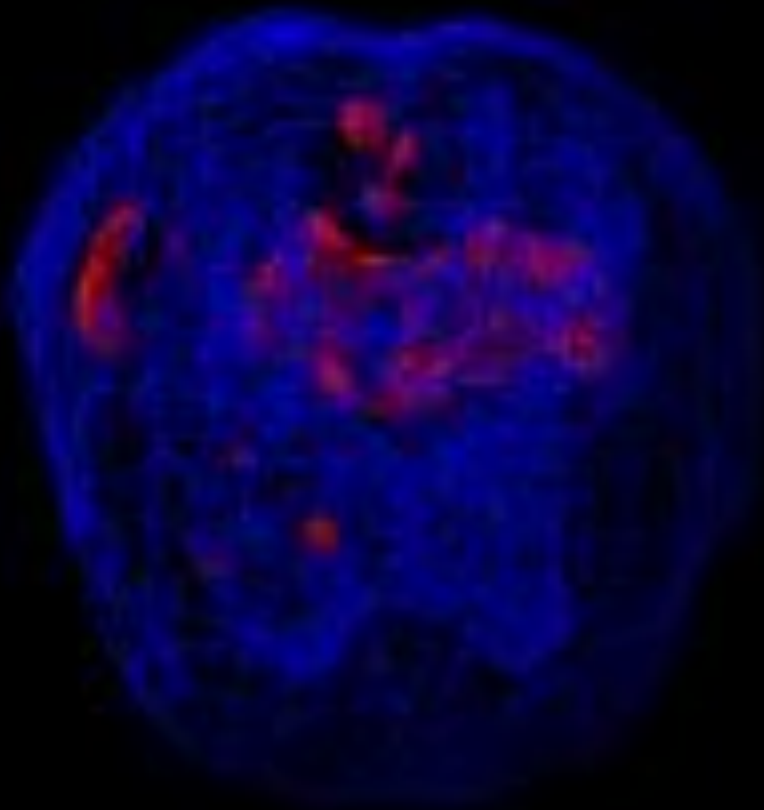


%

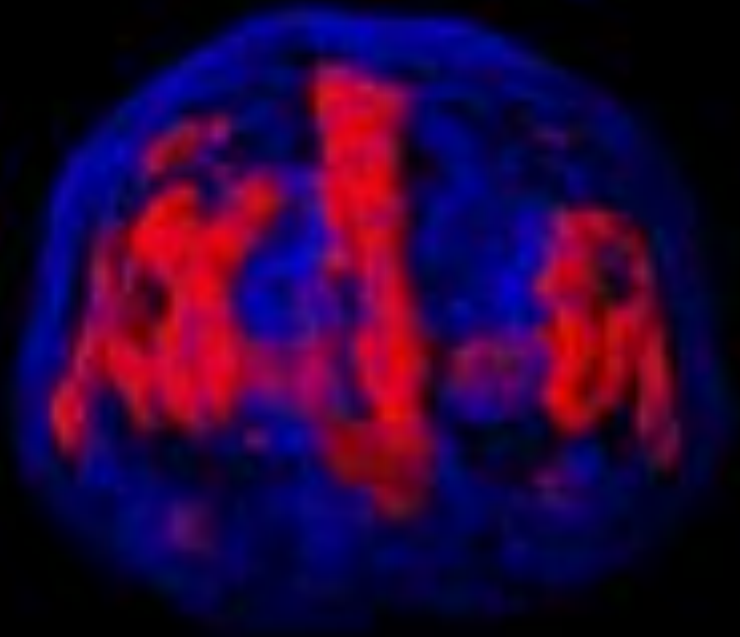
**TOTAL ENERGY EXPENDITURE**



# CALM



# STRESS



If we can limit the expenditure of energy during the waking hours we can build energy reserves for high level physical /mental activity. Much of this can be utilized in CNS readiness!



High<sub>MR</sub> = lost fuels  
Structural fatigue  
Lost CNS readiness  
Lost performance

# Wasting Energy





# Monitoring STRESS and RECOVERY

TRAVEL STRESS  
JOB STRESS  
RELATIONSHIP STRESS  
FAMILY STRESS  
PHYSICAL STRESS  
EMOTIONAL STRESS  
METABOLIC STRESS

TV VIDEOS  
TEXTING  
FACEBOOK  
SOCIAL LIFE  
AFFILIATIONS  
ACADEMICS



# READINESS TO TRAIN/COMPETE



## Poor recovery

Increased risk of  
overtraining

## Moderate recovery

Easy training  
recommended

## Good recovery

No risk of  
overtraining



2:1

AWAKE  
STRESS

ASLEEP  
RECOVER



16 HOURS

8 HOURS

DAILY STRESS





HRV



HEARTRATE VARIABILITY



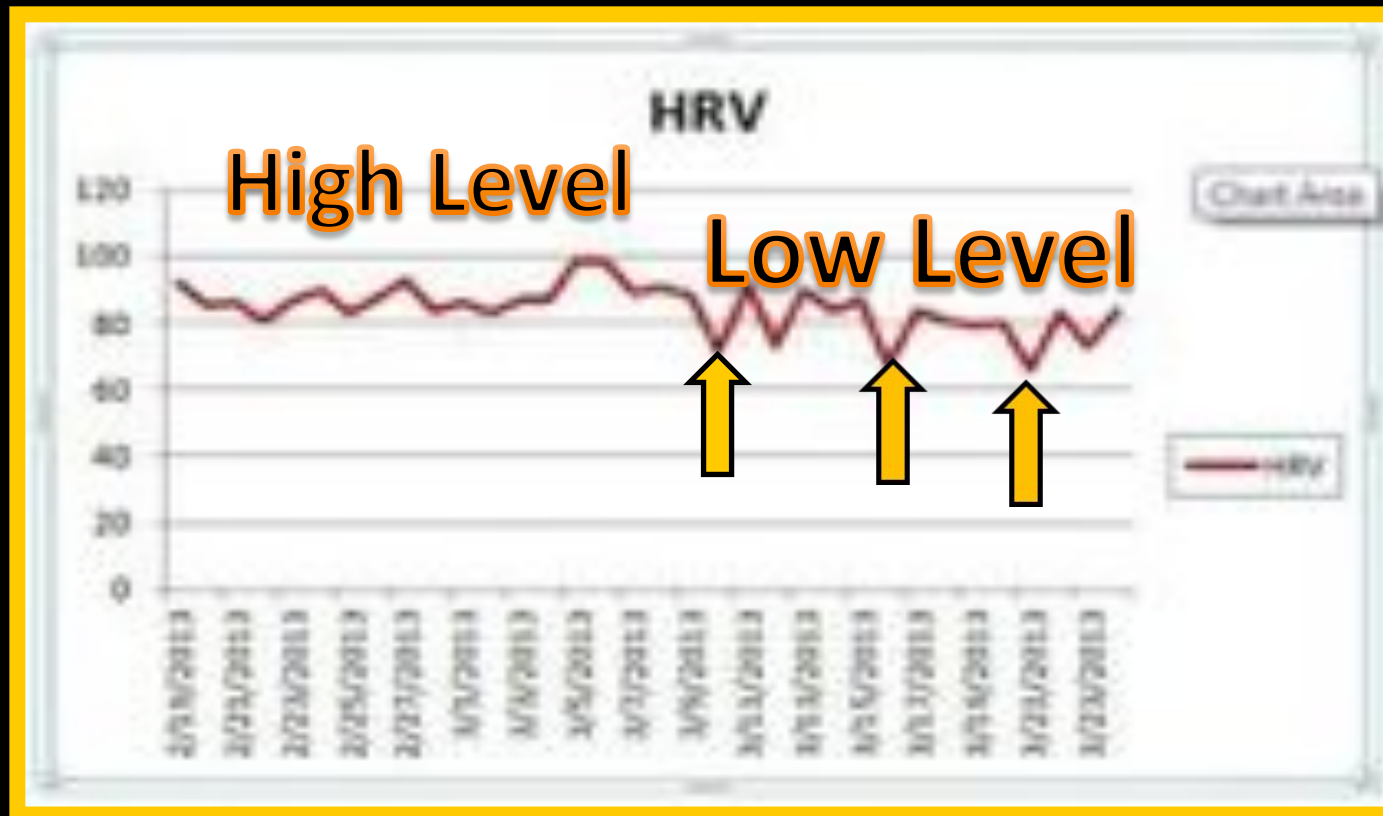
**Abstract.**  
Achievement status  
Level of needs  
Anxiety, fatigue

## Normal profile

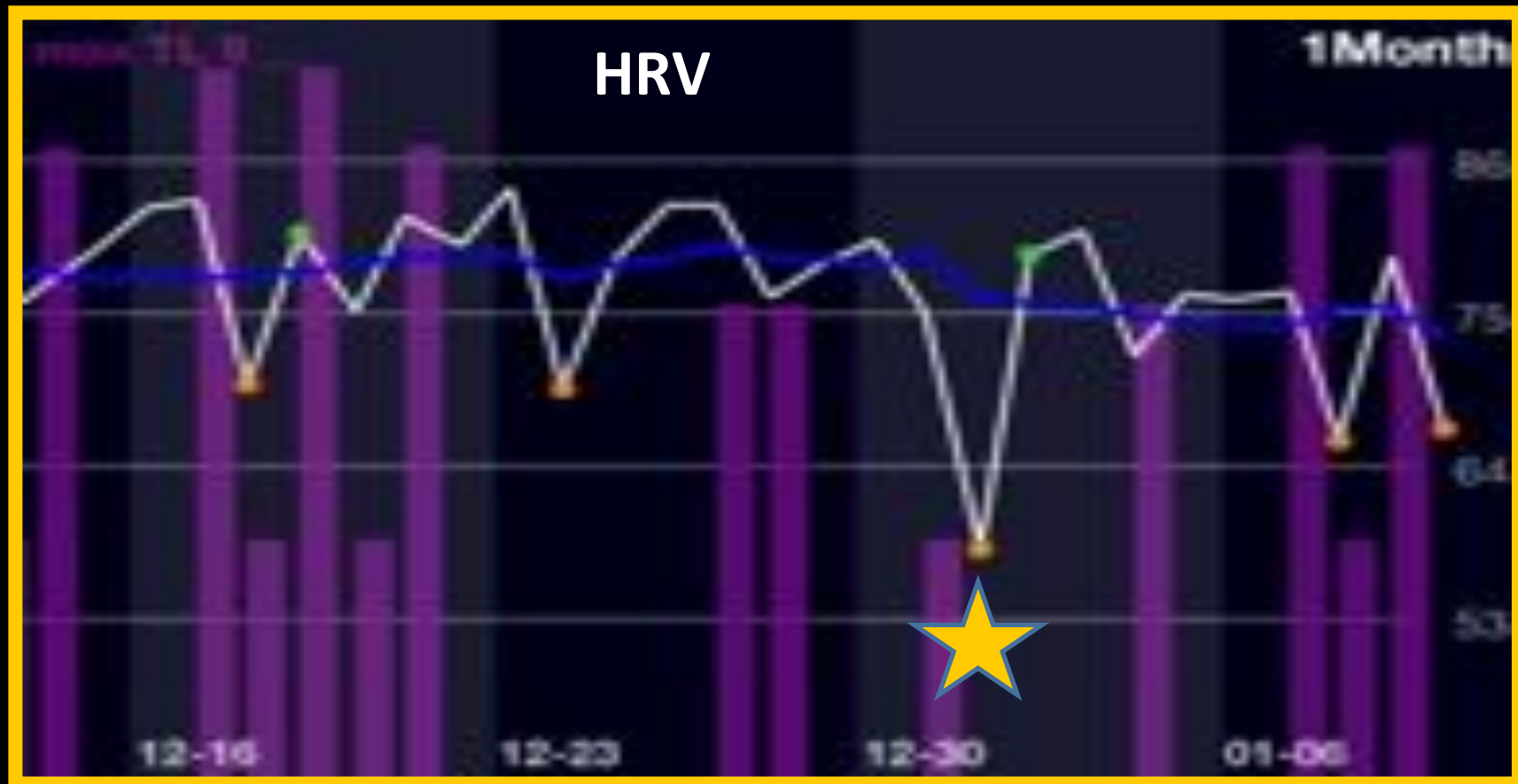
454



# Disturbances



The three lowest dips on the trend all occur in March after nights out drinking on the 10th, 16th and 23rd. The dip from the 12th is reported to be caused by other stressors.



A marked drop in HRV on New Year's day following a late night of NYE celebration that included alcohol consumption.

# Reaction Time best indicator of CNS Recovery/Readiness



## Sending Signals





**Reaction Time**



**SENSORY MOTOR**

A high jumper in a red singlet is captured mid-air, performing a Fosbury Flop over a bar. The athlete's body is arched, with one leg extended forward and the other bent. The background is a blurred crowd in a stadium.

.186 Sec.

Under training conditions elite skill based reactions are at about .186 msec.

TEST FINISHED

some people will find that the last score, when the dot flashed up big, was their quickest reaction time. This generally means that the rest of the time, you were not using your 'startle' reflex to react quickly.

your average reaction time was 0.136  
...that's fast!

**back**

**times - seconds**

0.166

0.211

0.167

0.204

0.183

**average** 0.196

# Reaction Timing Test



# SLEEP



The Importance of SLEEP  
in Mental and Physical Performance



NEVER  
SLEEP

Never  
Win

Sleep is an absolute predictor  
of performance in any sport

The more you sleep the better you play...



# SLEEP

Just a decrease of 1.5 hours of normal sleep time can result in a 30% drop in alertness

Life <sup>of</sup> an  
Athlete

**6 Hours 40 Minutes**  
**4-6 Hours**



**Average sleep for most athletes**

# 27% < 6 HOURS 17% 8 HOURS>

HOURS OF SLEEP

1 2 3 4 5 6 7 8 9 10 HRS

## SLEEP

There is no way to overcome the deficits of lost sleep. Nightly REM sleep is the only way to reboot, reenergize and restore the brain and CNS to levels for optimal performance.

Life of an  
Athlete



# REACT

Twenty four elite athletes reaction  
time to visual stimulus rested:

**.186** Sec.

Twenty four elite athletes reaction  
time no sleep overnight:



**.246** Sec.



## Don't fight it... SLEEP



To train and compete at a high level, you need regular sleep cycles. That means you need to go to bed at night at the same time every day... Even on weekends. Your body gets used to being physiological responses during sleep and they happen at certain times during the night. Sleep includes muscle restorative phases, organ restorative phases and brain and CNS restorative phases. If you have random sleep patterns, these responses will be random. Optimal recovery and adaptation occurs based on these cycles. In the recent Stanford Sleep Studies it was proven that the more you sleep the better you perform.



Life of an Athlete  
Human Performance Project

**Muscle Restorative**  
**Organ Restorative**  
**CNS Restorative**



# Stanford Sleep Studies

Cheri Mah

The more you sleep the better you perform  
Universal + effect on performance  
All stats improve in competition level performance  
All improve in measured core battery of tests  
Most personal bests/records set

Sleep is an absolute predictor of performance in any sport!



Lifestyle  
Strikes  
Back



# Sleep.

Now Clearly a Predictor  
of Performance

By Dr. Matthew Walker, Director of the Center for Human Sleep Science, University of California, Berkeley

**W**hen you spend the night in bed, your brain is not just resting. It is actively processing information, consolidating memories, and regulating emotions. It is also clearing out toxins that have built up in your brain during the day. Sleep is essential for your health and performance. Without it, you will feel tired, irritable, and your performance will suffer. In fact, sleep deprivation can lead to a 30% decrease in performance. So, if you want to be at your best, you need to get enough sleep. That's the bottom line. Sleep is the foundation of your health and performance. Without it, you are building on a shaky foundation. So, make sleep a priority. It's the only way to truly win.

© 2019 Dr. Matthew Walker. All rights reserved.

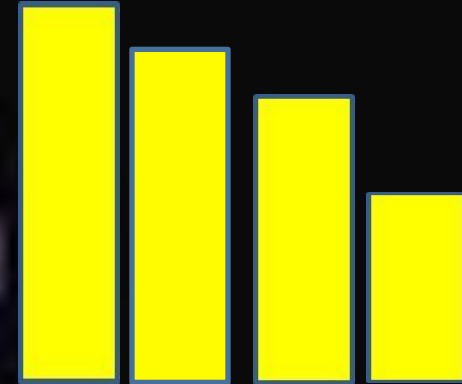
# HERE'S TO THE AFTER HOURS ATHLETE

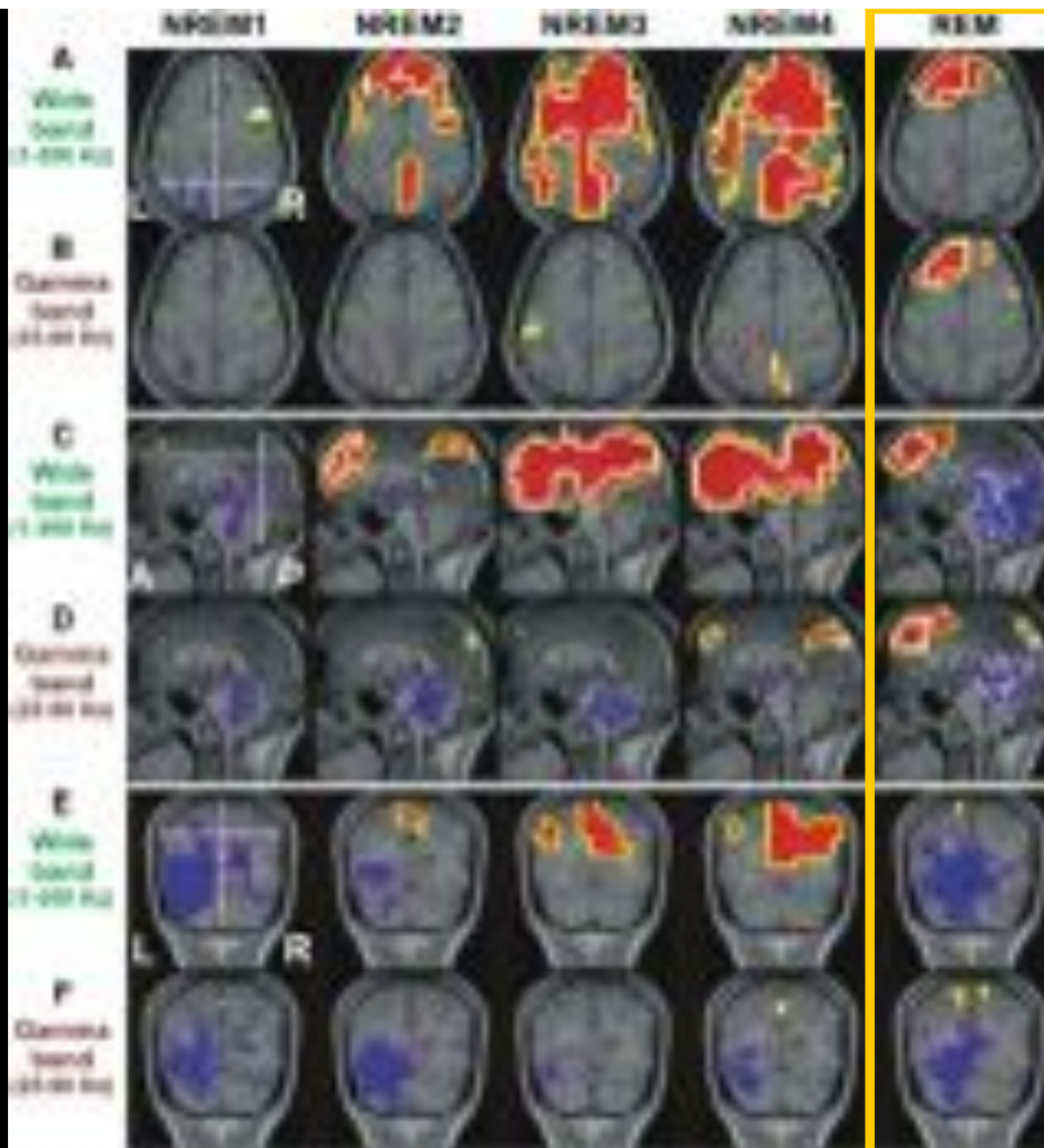
Life <sup>for</sup>  
~~Athlete~~

Go waste your effort,  
throw away your work!



11/2 - 21/2 HOURS  
OF REM  
IN 24 HOURS



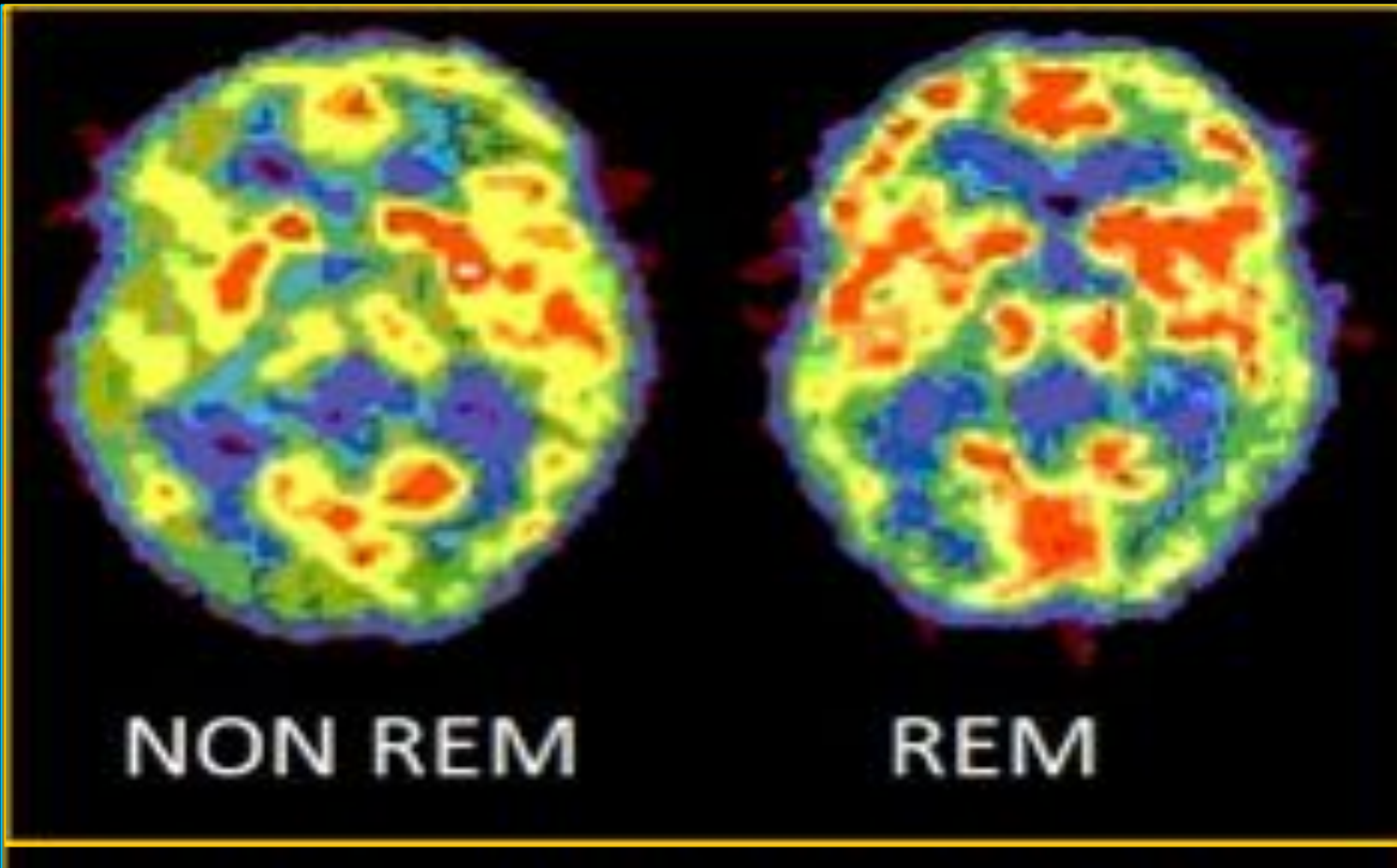


R

E

M

RECHARGE



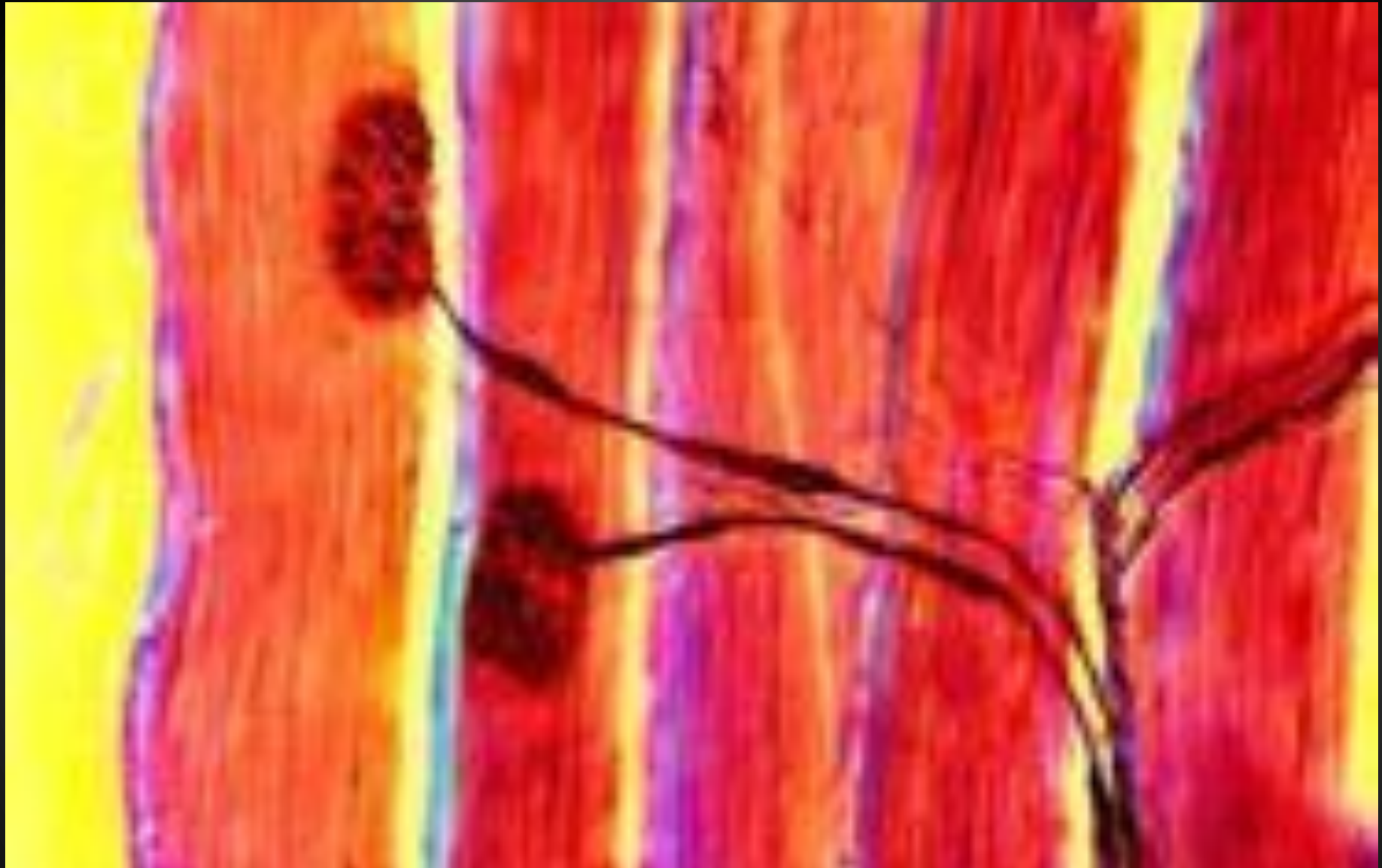
You need 1 ½ - 2 1/2 hours of REM  
You need 8 hours of total sleep to get it



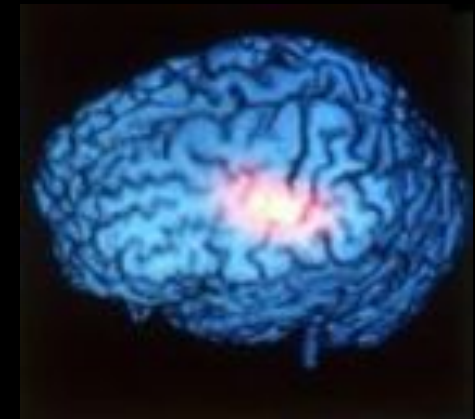
## NEURONAL REPAIR

Improper amounts of sleep may cause those same neuronal pathways to become so depleted of energy or flooded with byproducts of cellular activity that they malfunction.





Neuro-Muscular Junction



# **Movement Memory**

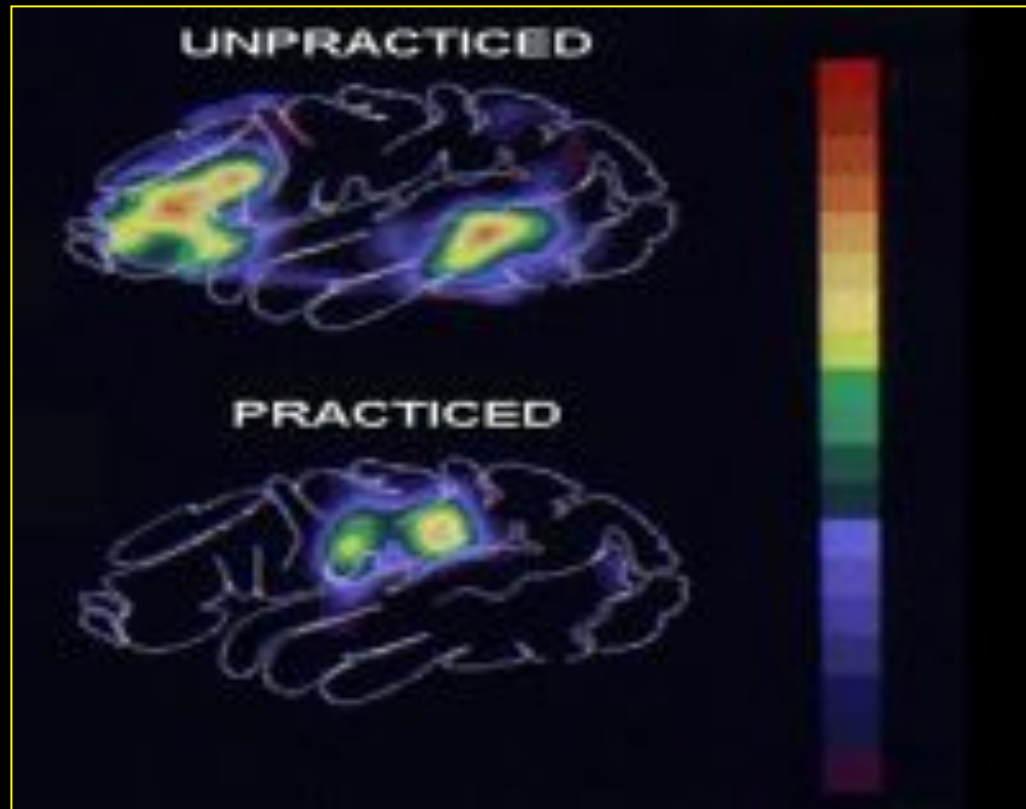
## **Firing Patterns**

## **Biomechanics**

## **Efficiency**



# Skill Development



Perfection  
Innovation  
Efficiency



# SLEEP



Chronic sleep loss results in a 30-40% decrease in glucose metabolism.

No Fuels    No Energy    No Performance



**4-6 HOURS**

**40-54 MINS**

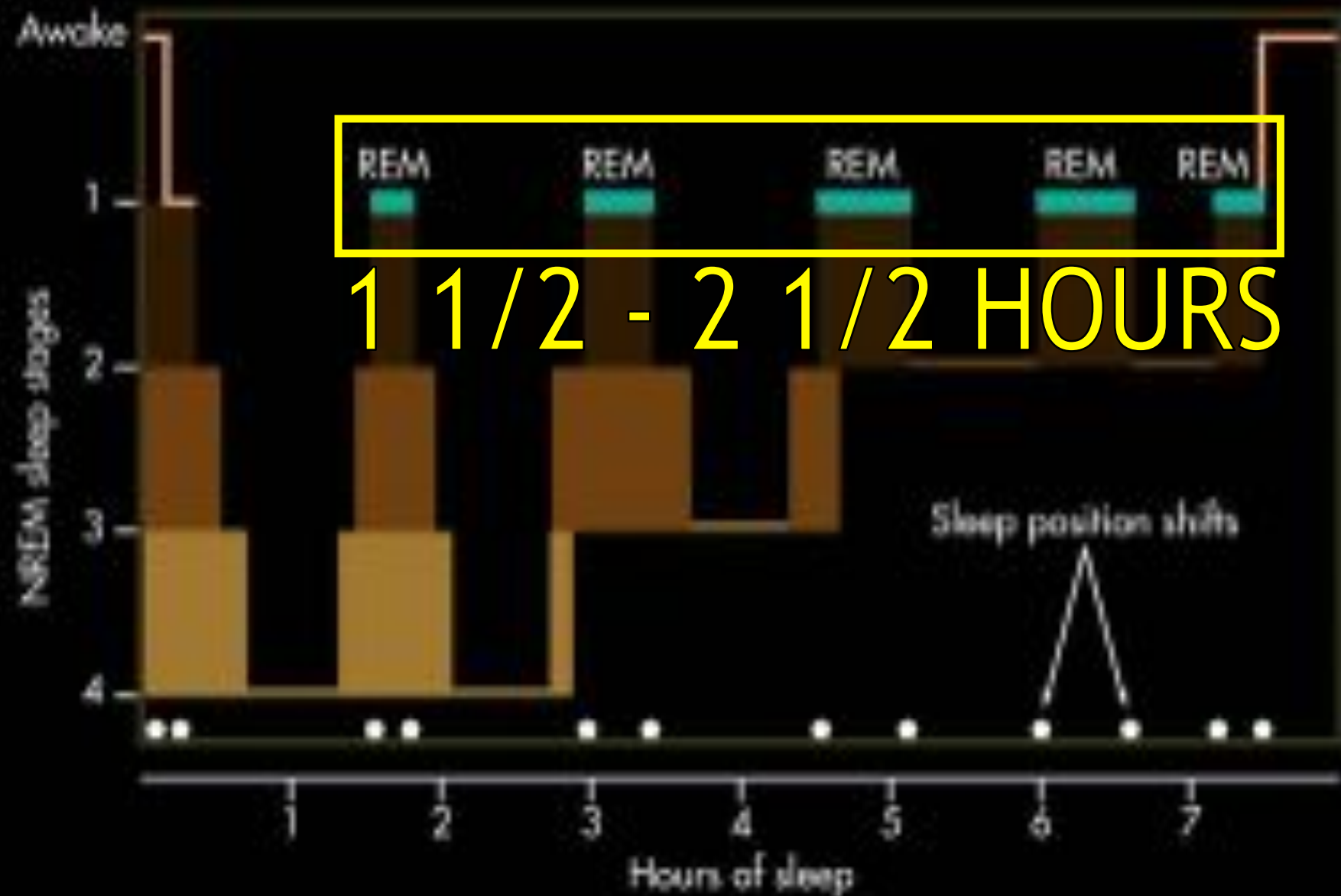
**TOTAL SLEEP**

**ACCUMULATED REM**

**8 HOURS**

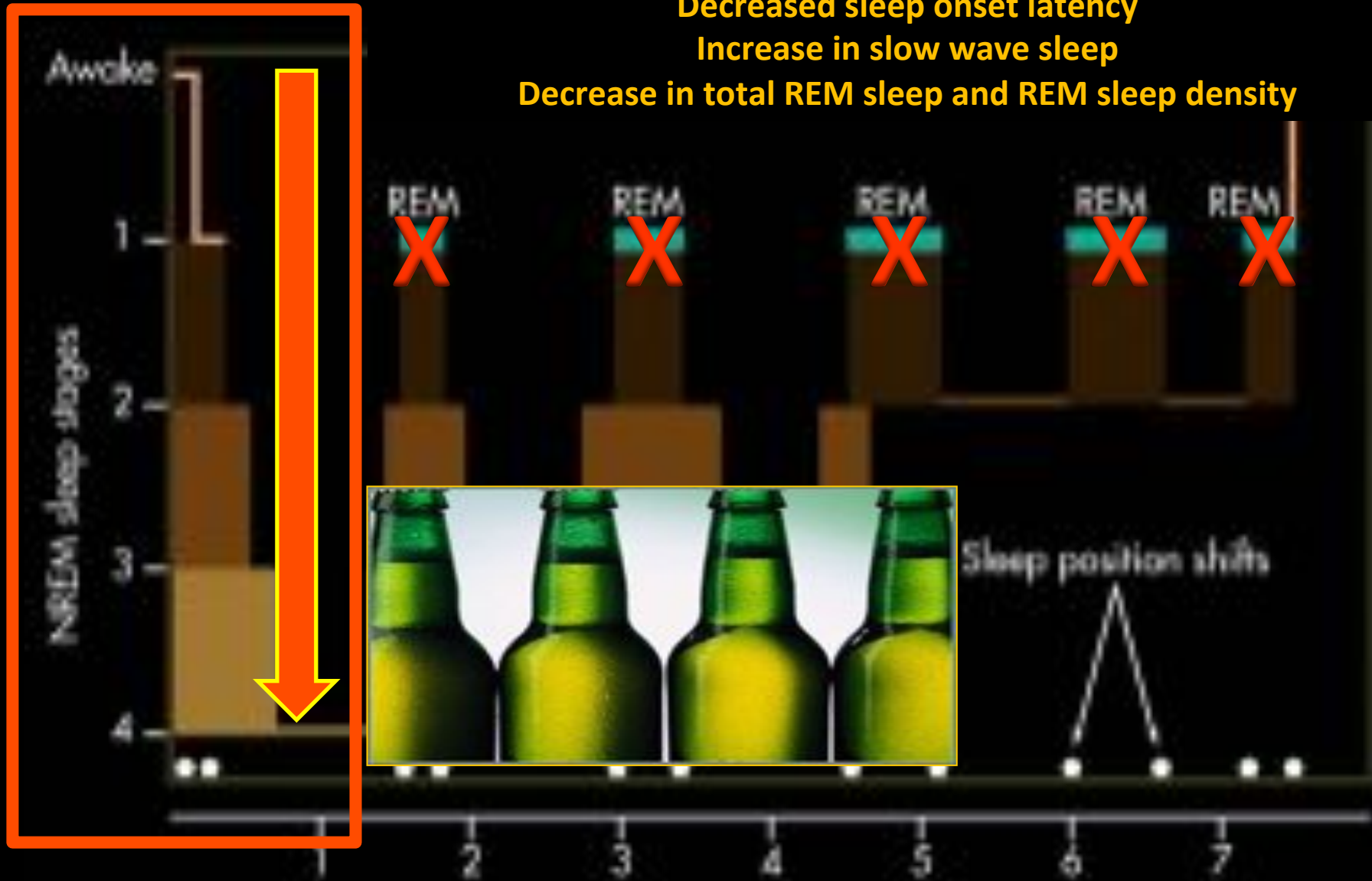
**1 ½ - 2½ HOURS**





8 HOURS OF SLEEP

Decreased sleep onset latency  
Increase in slow wave sleep  
Decrease in total REM sleep and REM sleep density



Transition to deep sleep  
Lost REM

# REM and Alcohol Use



Life of an Athlete  
human performance project

You wake up the next day with an exhausted brain and central nervous system. Your alertness levels are decreased. Your level of focus is decreased. Your attention span is decreased. Your ability to process information is decreased. Your reaction time is 25% slower. Time to exhaustion is decreased. Perception of fatigue is higher!

2:27

1:31

:58

:31



None

1-2

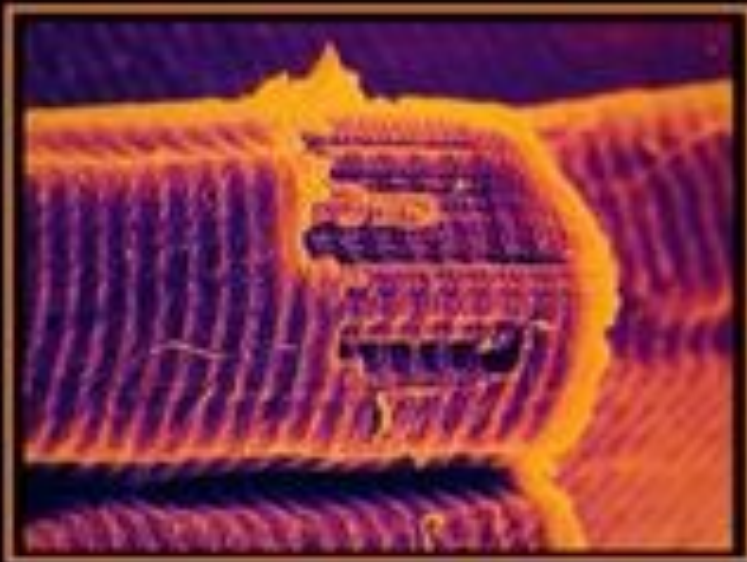
3-4

5>



8 HOURS OF SLEEP

# Sleep and GROW



Sleep is a critical component in the muscle building process and should not be overlooked. Your muscle tissue repairs itself and grows during rest periods but sleep is more important than waking rest periods.

Here's why:



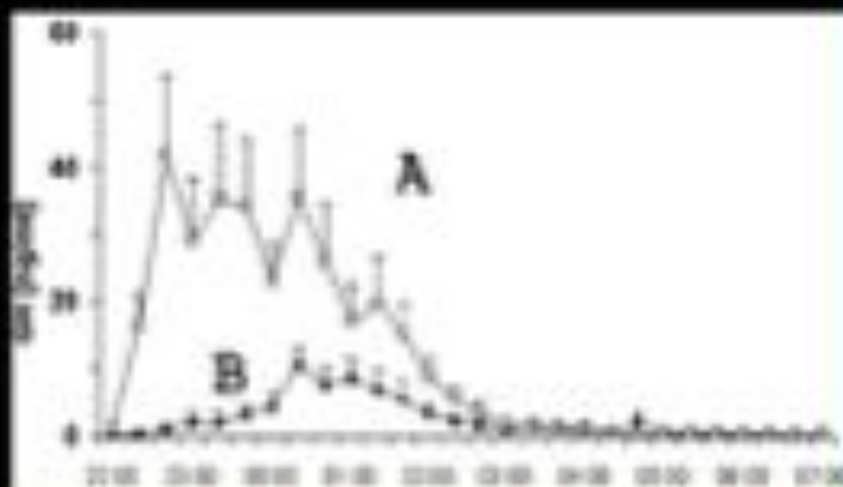
Life of an Athlete  
Human Performance Project

The release of growth hormone reaches its peak during deep sleep

Your metabolic rate slows which is perfect for muscle tissue repair and growth

Increased blood flow to the muscles

## HGH Release at night



A. sleep from 10pm. - 6am.

B. Sleep from 12am. - 8am.

early... Lots of HGH

used during the earlier hours of the  
 later hours. Thus, sleep schedules are  
 A 8 hours of sleep from 10 pm to 6  
 or GH release than B 8 hours of sleep  
 8 am. The above diagram shows pulses  
 corresponding to the four sleep  
 during an average good night's sleep.



Life of an Athlete  
 Human Performance Project

# I-net Generation





ATHLETE TIME  
MANAGEMENT  
VERSUS  
TECHNOLOGY

Life of  
Athlete

STRESS  
TIME LOSS  
CNS FATIGUE  
RECOVERY DELAYS  
METABOLISM CHANGES  
LOSS OF FOCUS

Technology has increased significantly the sedentary hours per week for all populations including athletes.





Visual Cortex Energy Drain 

During an athletic  
competition,

YOUR EYES PROCESS  
MORE THAN

120  
MILLION  
BITS OF  
INFORMATION  
EVERY SECOND.



# READ

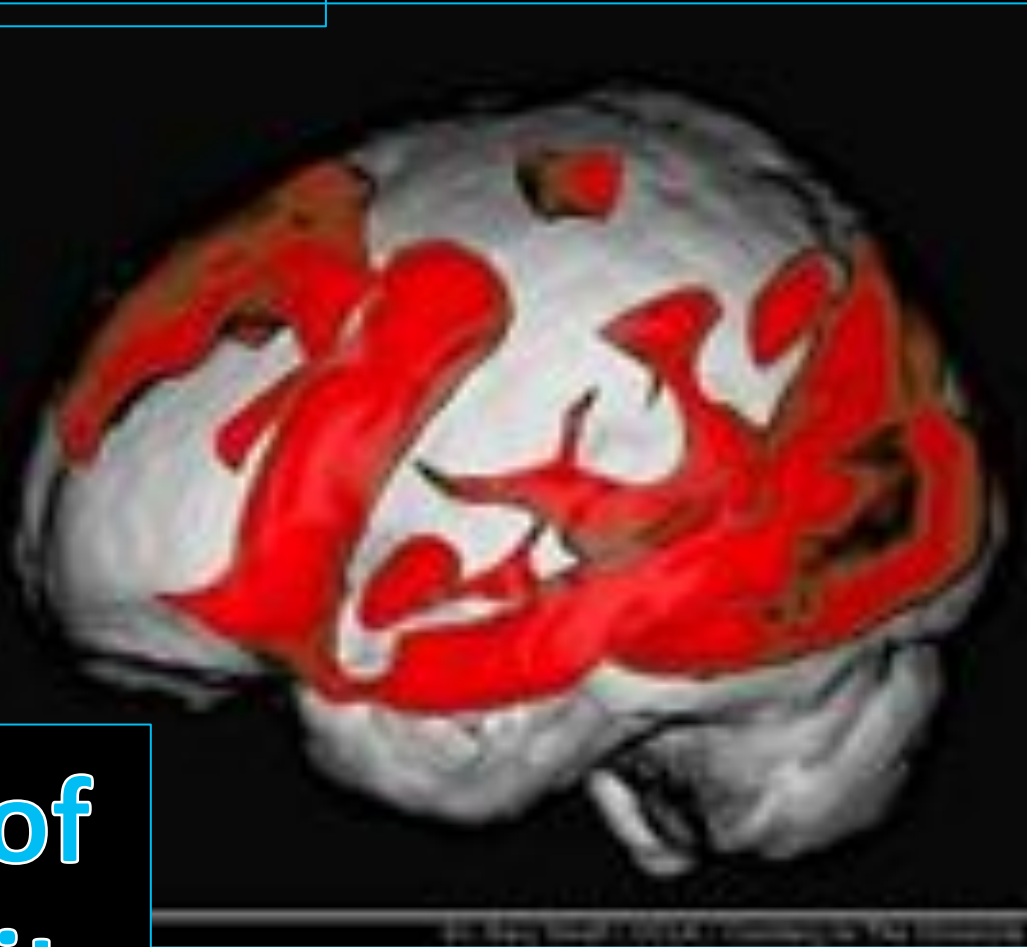


# INTERNET

**Rest means Rest...**

The CNS can rest  
and reboot  
critical energy  
when the brain  
function is  
minimal...

**Nearly 2/3 of  
brains activity**



# Biggest Drain



Tracking/following  
moving objects

Depth between  
objects

Speed/Velocity  
objects travel

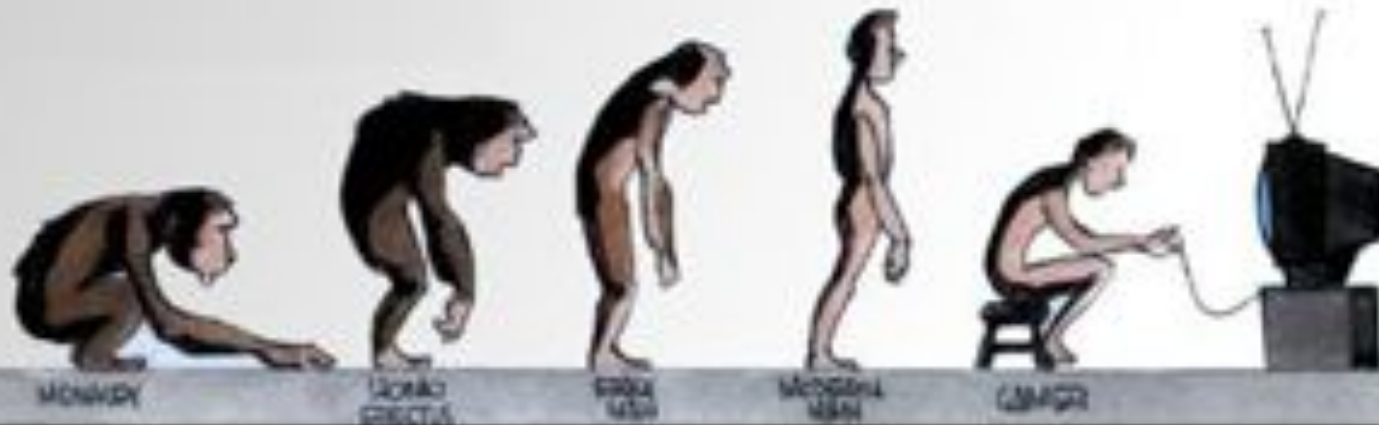
The visual cortex drains much of the CNS  
energy during the waking hours.



VIDEO



GAMES





Studies conducted at London's Hammersmith Hospital found that dopamine levels in players' brains doubled while competing in video games.

"I really only play Xbox," "I have been playing a lot of Call of Duty recently. I find myself playing like 30 hours per week. People don't know it's [me]. It is fun, I am very competitive in everything I do."

Michael Phelps



The background of the slide features a wireframe profile of a human head in profile, facing right. The background is a warm, orange-brown color with a pattern of binary code (0s and 1s) and a heatmap-like texture. A black rectangular box with a yellow border is centered on the left side of the slide, containing the text "TECHNOLOGY BASED LIFESTYLE" in a yellow, outlined, serif font.

# TECHNOLOGY BASED LIFESTYLE

Is not conducive to optimal training,  
recovery, adaptation or performance.

# Tech creates problems



## Blue Light Disturbances

Blue light from a shift all day, blue light from your computer screen at midnight - it makes an difference to our circadian rhythm. It's all the same to our bodies, because for millions of years blue light meant daylight, not late night texting or channel flipping on TV and it's the blue light specifically that appears to mess up our sleep patterns the most. Computer screens, iPhones, TV as I said used late into the night disturb your entire physiological processes. Keep that you need for sport?

The adverse effects of night-time light on sleep and circadian rhythm can be reduced by replacing blue-enriched light with red or orange-enriched white light after sunset.

Using these devices in total darkness makes the problem even worse!

Get a hint as your body can get into a Bio-Rhythm...

It is critical to establish a regular bedtime and wake time. The interval between these two times must allow a person to reach enough sleep. Athletes need more sleep. A typical high school or college athlete would need more than nine hours of sleep.



Life of an Athlete  
Human Performance Project



# Brain Stimulation



## BLUE LIGHT IS EVIL FOR ATHLETES

Blue light is bad for our health – in the worst sense. When we're exposed to levels of anything as intense as the intensity of what we would have experienced for the bulk of our evolutionary history, problems arise. Blue light impedes our secretion of melatonin, the sleep hormone. Exposed to blue light, we limit the production of melatonin, and as they sleep and awaken in the absence of blue light, melatonin production ramps up, and we get sleepy. This system worked quite well for a long time. Reddish light from fire (our primary source of nighttime illumination) has little to no effect on melatonin production, so sleep wasn't disrupted when we relied on fire. These days, though, we're subject to a steady barrage of blue light. During the day, blue light (natural or artificial) isn't such a problem because we're supposed to be awake. But at night, when we're "supposed" to be getting ready to sleep, we tend to put up blots of blue light emanating appliances, and our sleep suffers for it. We minimize our release of melatonin and stay alert and stimulated rather than becoming sleepy. Use of blue light often dinner is a bad idea for athletes who want to sleep and recover and release GH and get GH to robust the CNS and brain for your workout or competition tomorrow.



Life of an Athlete  
Human Performance Project

Delays brains transition from  
wake state to sleep





Blue Light

**Prevents Brain Shutdown**





## Blue Light Tips for Athletes

Exposing blue light is problematic, and there are some simple steps you can take to mitigate its late-night effect on your sleep.

Keep electronic usage to a minimum or completely eliminate blue light (cellars, TVs, laptops) after dark.

Go to sleep earlier.

Use candlelight.

Keep your room as dark as possible and your sleeping quarters pitch black.

Install a low intensity filter on your computer to cut down on blue light emissions.

If you want to try a somewhat serious experiment you could even wear orange safety glasses at night.

Do not use blue light devices in total darkness (see pic)

Blue light keeps you awake and throws off your bio-rhythm!



Life of an Athlete  
Human Performance Project

# Limit blue light at night





**Avoid Blue Light  
and total darkness**





f.lux options



Life of an Athlete  
Run Performance Project

Change to PINK





UNIVERSITY OF ARIZONA  
PAUL G. HENNINGSEN, M.D.



## Blue Light Reducing Computer Glasses

Blue light acts differently on the retina than the rest of the light color spectrum. Ever look at a blue LED and noticed a haze around the light? Staring at it gives you a headache, doesn't it? Doesn't it? Your eyes are straining to try and bring that haze and the focus, and it just isn't.

Exposed to blue light, we limit the production of the melatonin sleep hormone, and release positive and alert, in the absence of blue light, however, melatonin production increases and we get tired.

Getting enough sleep is a task that challenges many athletes, but doing what you can to help your body rest naturally can greatly improve the quality of the sleep that you are able to get. By avoiding blue light in the evening and right before bed, you can help your body produce the optimal amount of melatonin and you can fall asleep in a natural way. Additionally, you will reap all of the benefits that a healthy sleep cycle provides, which is pivotal to recovery in all body systems. Optimal training requires sufficient sleep.

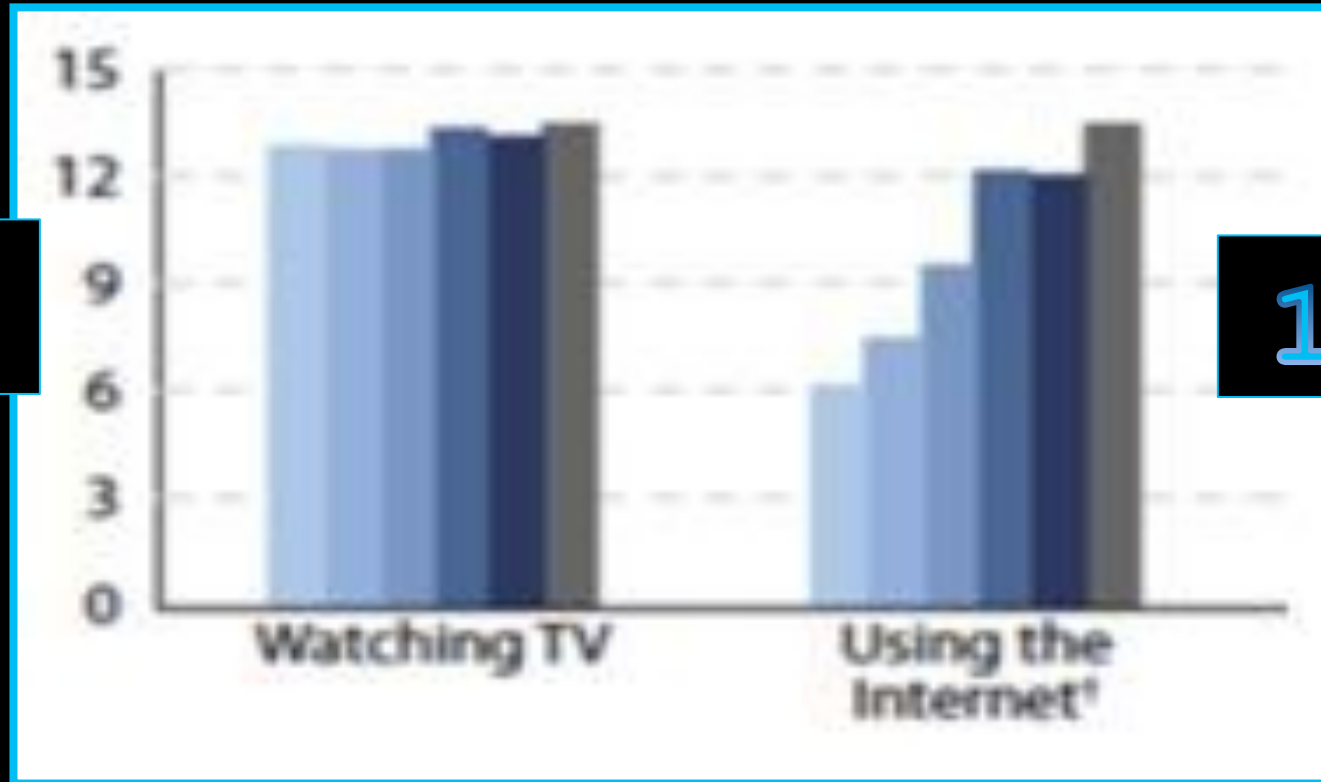
# Filters



13 HRS

13 HRS

5%



121%

INCREASE IN TV AND INTERNET TIME IN LAST FIVE YEARS

26 HOURS PER WEEK





+10-15-20 Hours





## High level populations can use blue light to advantages!

Just like blue light wavelengths can be detrimental to falling asleep, it can also help the brain stay stimulated under CNS fatigue conditions or help speed up the waking reflex in those who need to get highly functional after sleep. RPT in upstate NY is developing these blue light glasses to help with sleep disorders but they also have application for stimulation. Blue light could be utilized shortly after awakening to shorten the grogginess and cathesize more experience prior to a morning workout. When we consider that morning is now the optimal time for high level training, there is huge applications, said John Underwood, Director of the Human Performance Project.



Life of an Athlete  
Human Performance Project



# facebook

wasting athletes time since 2004

# Stimulants

There is no way  
to make up for  
the deficits of  
lost sleep with  
stimulants



ENERGY DRINKS





## Use of Stimulants for CNS Fatigue

Clearly any athlete that is suffering from serious CNS fatigue or Neural Fatigue NF knows that it will be a long painful training session. Many use energy drinks or stimulants or the original coffee or espresso. This is a huge mistake! The athlete will quickly experience an energy spike or surge within ten to twenty minutes and then rapidly sink into even greater deficits of NF. The only way to overcome NF is rest and in particular REM sleep. Power naps less than 30 minutes have been shown to elicit a 30% increase in alertness (NASA says 26 minutes) , but it will not overcome NF. So suffer through the session and head to bed early. It is no different than waiting for your body to recover from the poisoning of alcohol. You are at the mercy of the timeline for return to normalcy!



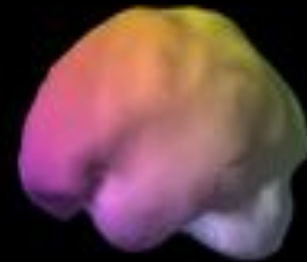
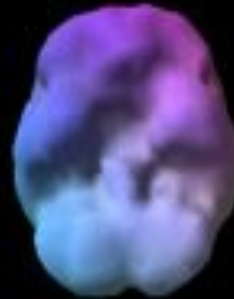
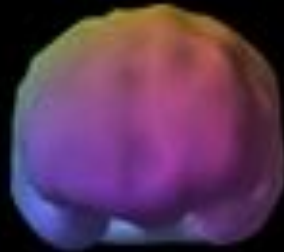
Life of an Athlete  
Human Performance Project



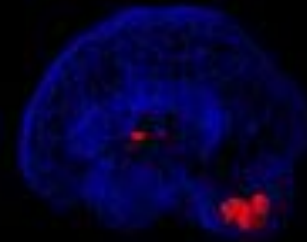
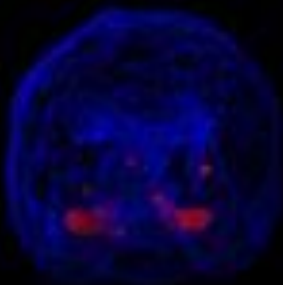
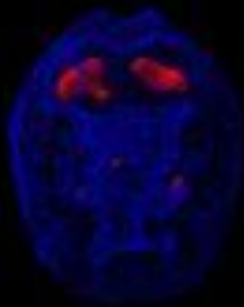


**What's this?**

## DAMAGE



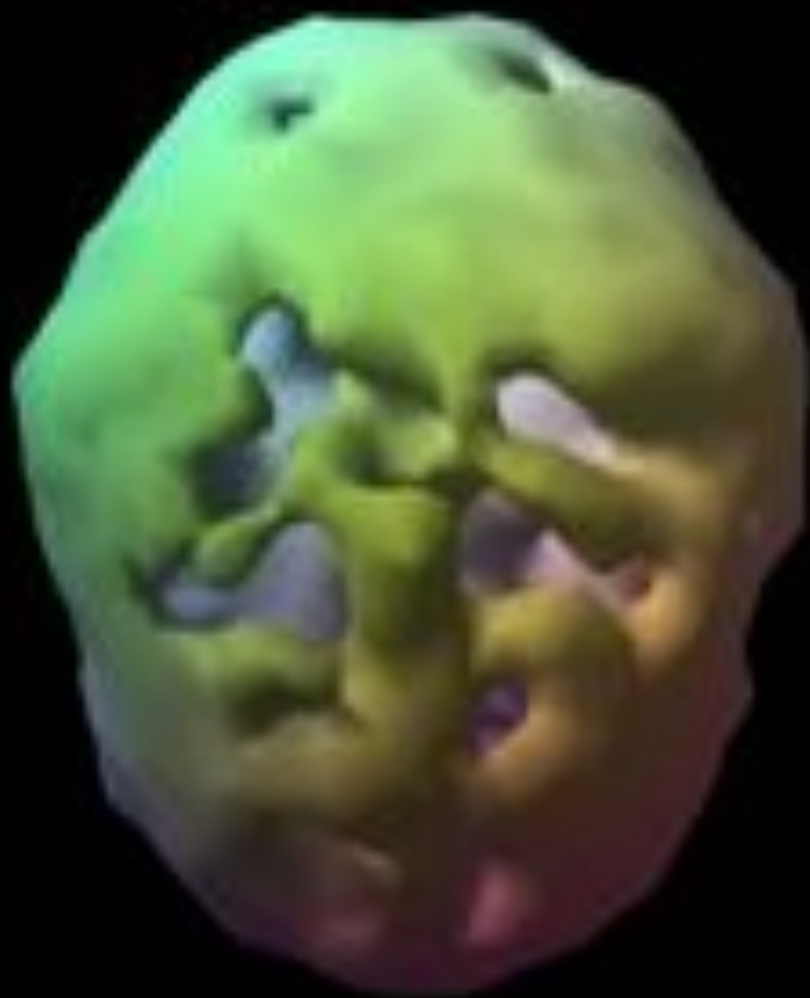
Single Photon Emission Computerized Tomography



## ACTIVITY

# SPECT





We now have  
indisputable  
evidence of  
systemic  
damage and  
cumulative  
damage.

**BRAIN SCIENCE ADVANCES**

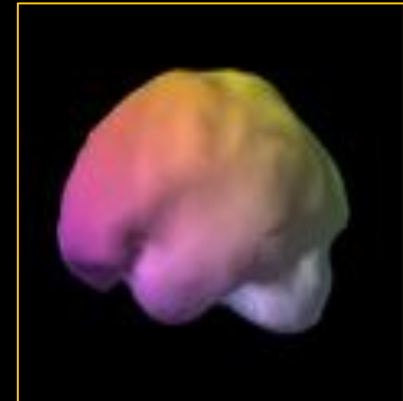
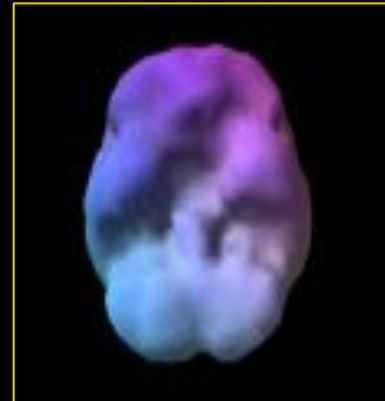
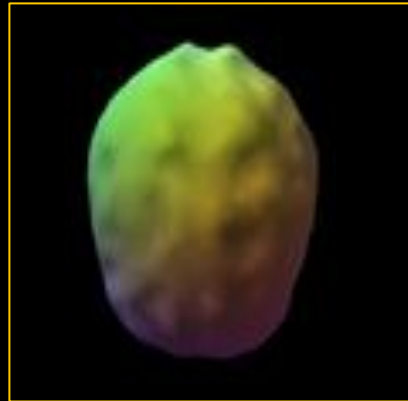


**TOP**

**FRONTAL**

**BOTTOM**

**SIDE**

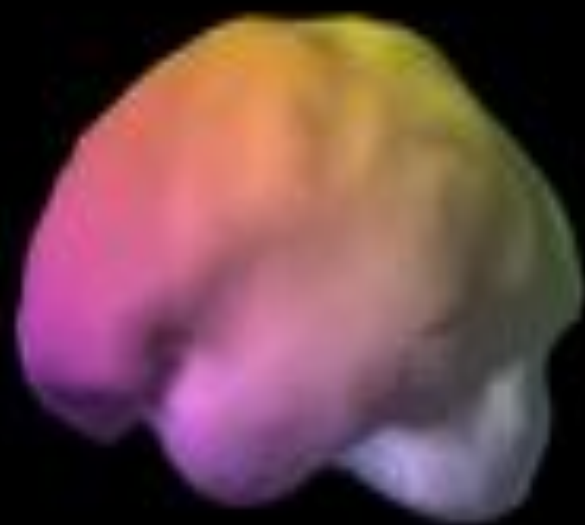


**NORMAL  
HEALTHY**

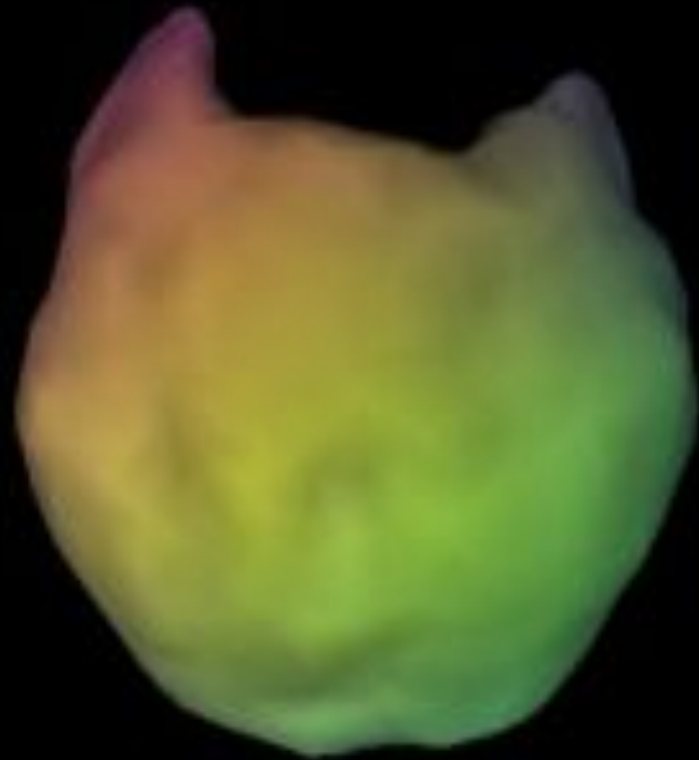
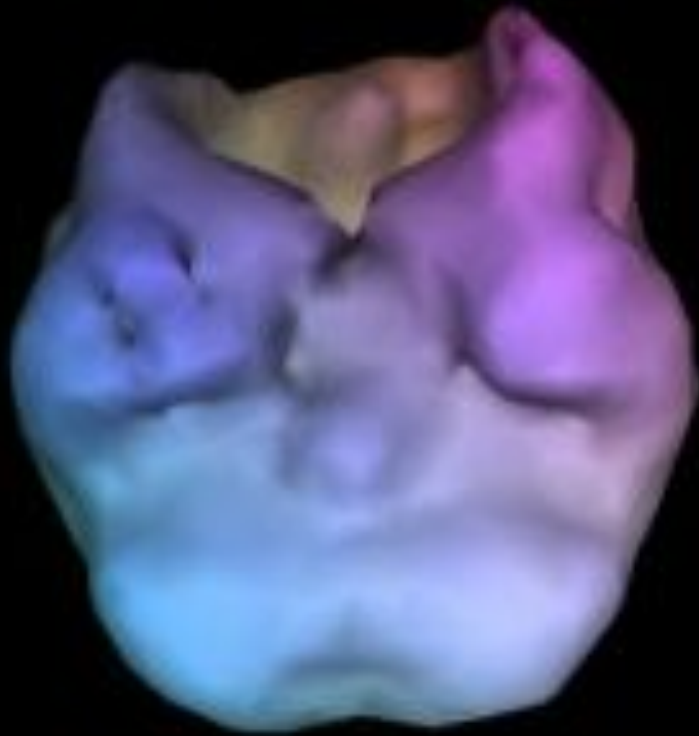




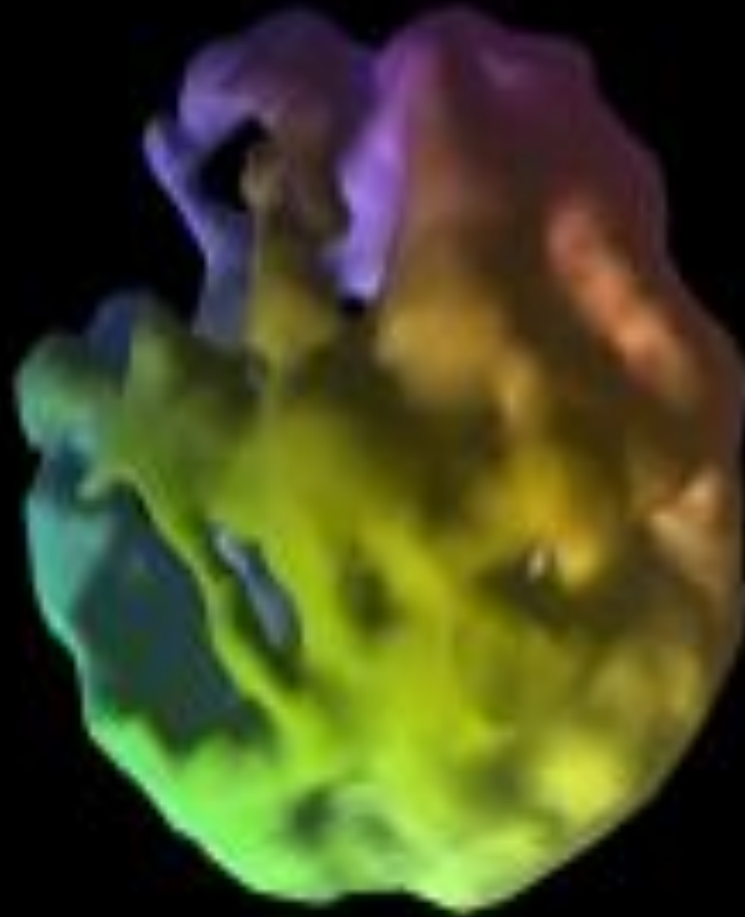
NORMAL HEALTHY



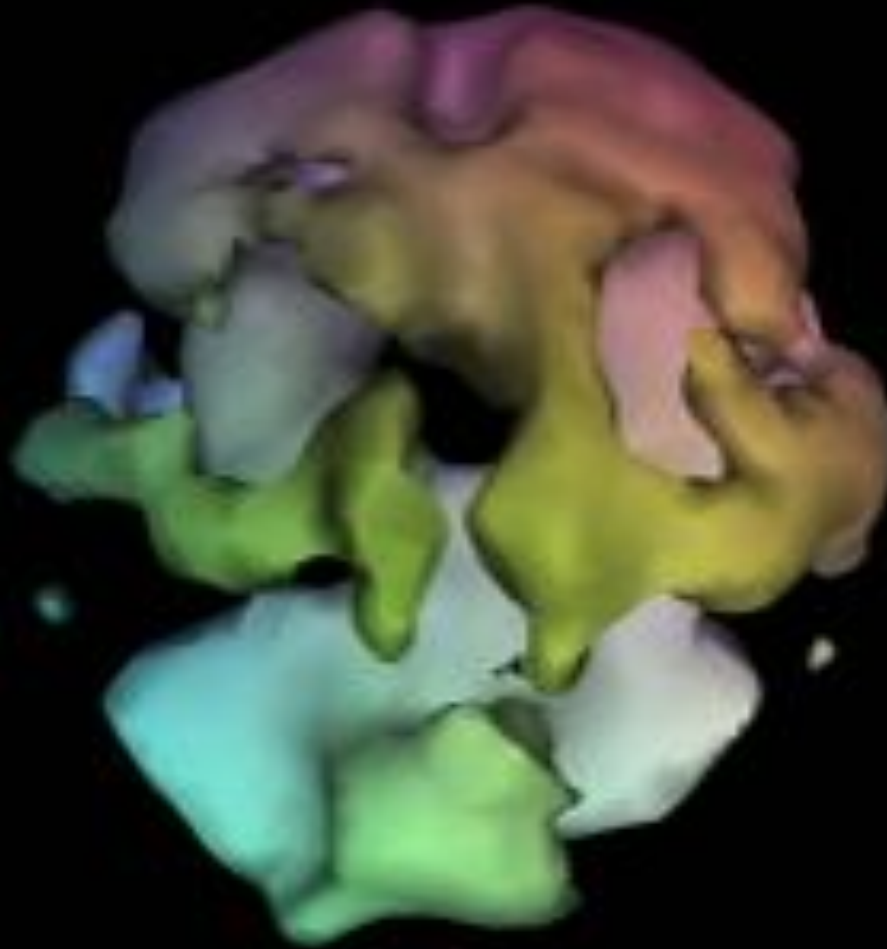
# Severe Brain Injury



# Stroke

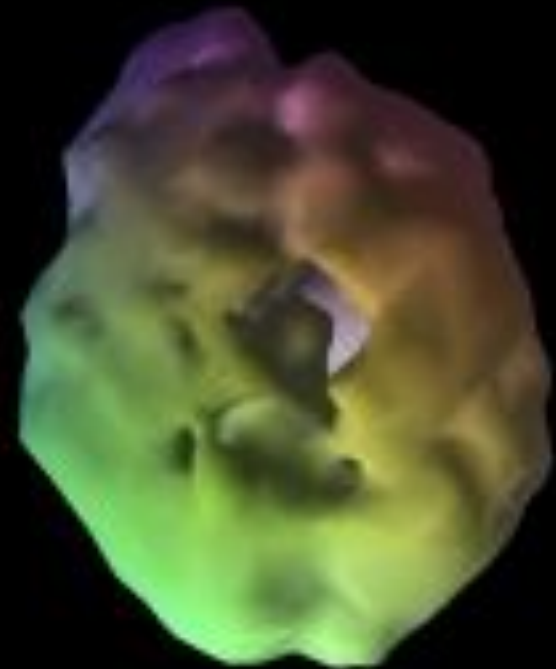


# Alzheimer's

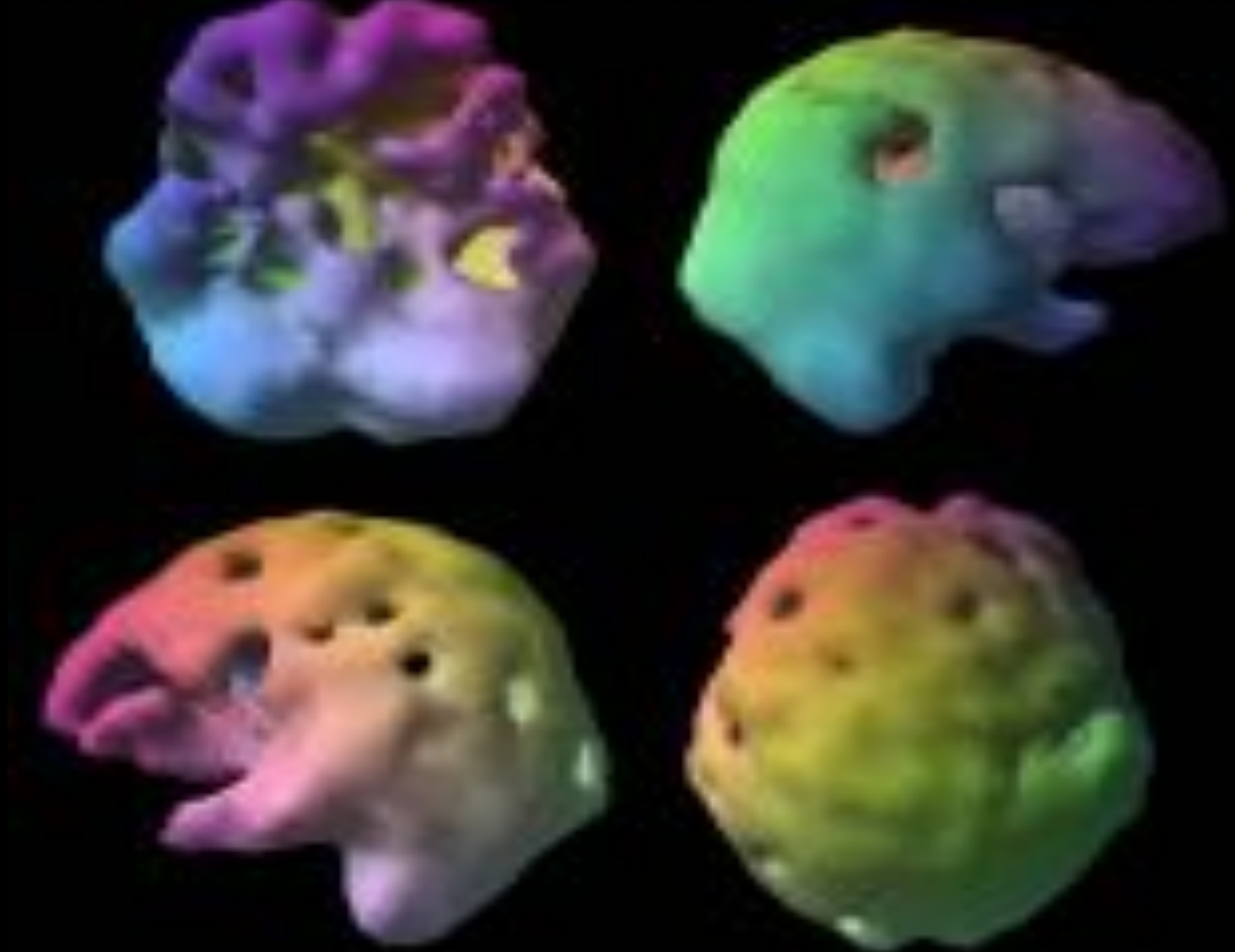


# Brain Degeneration

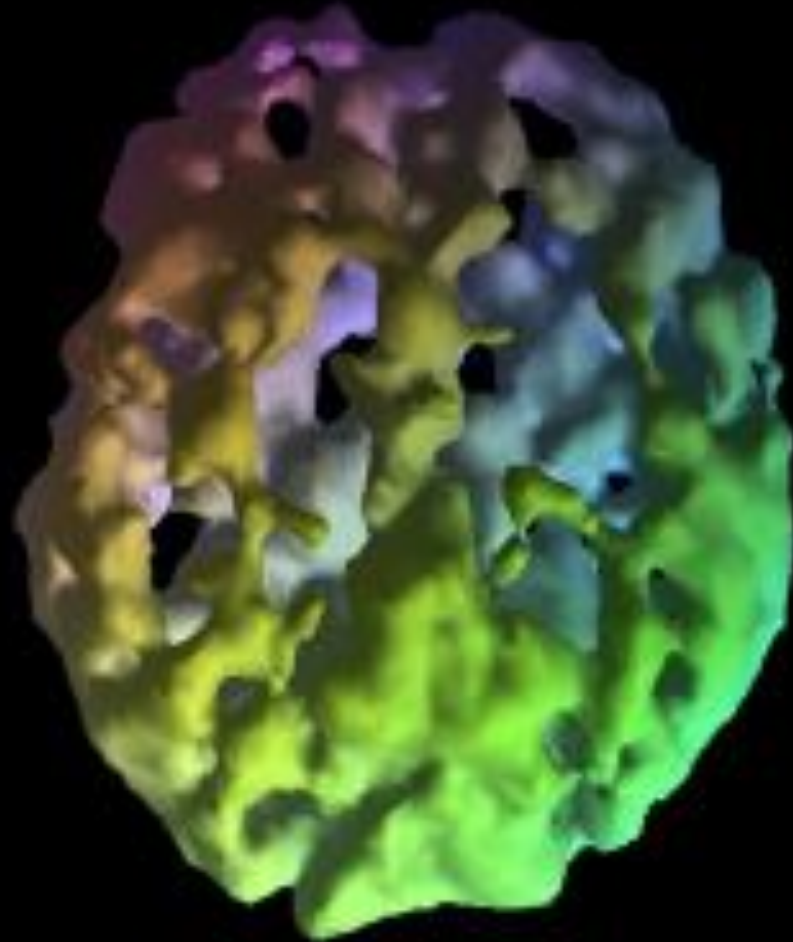
# NFL NHL BRAIN INJURY STUDIES



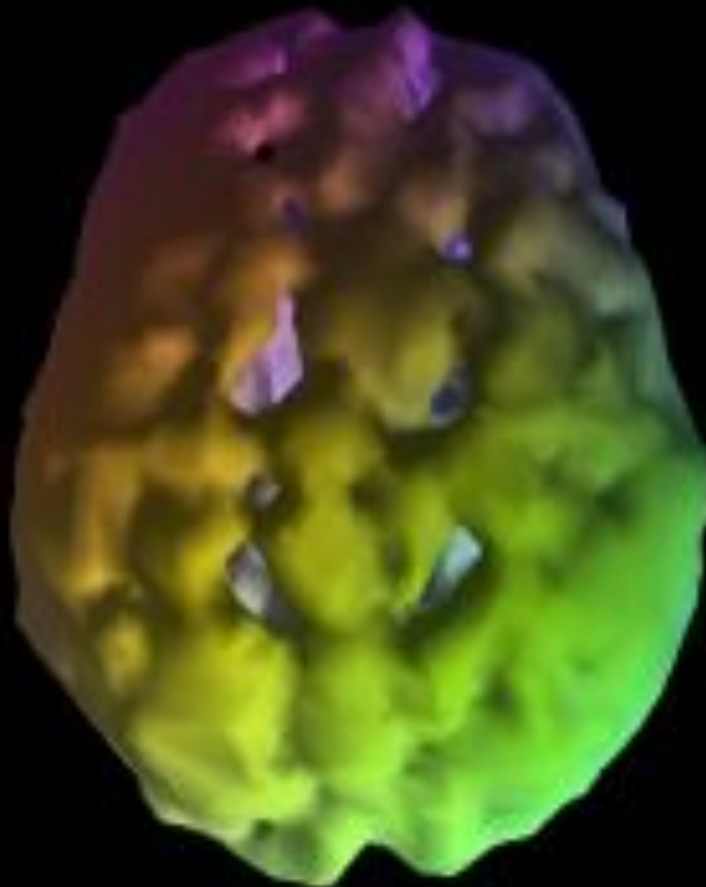
# MULTIPLE HEAD INJURIES



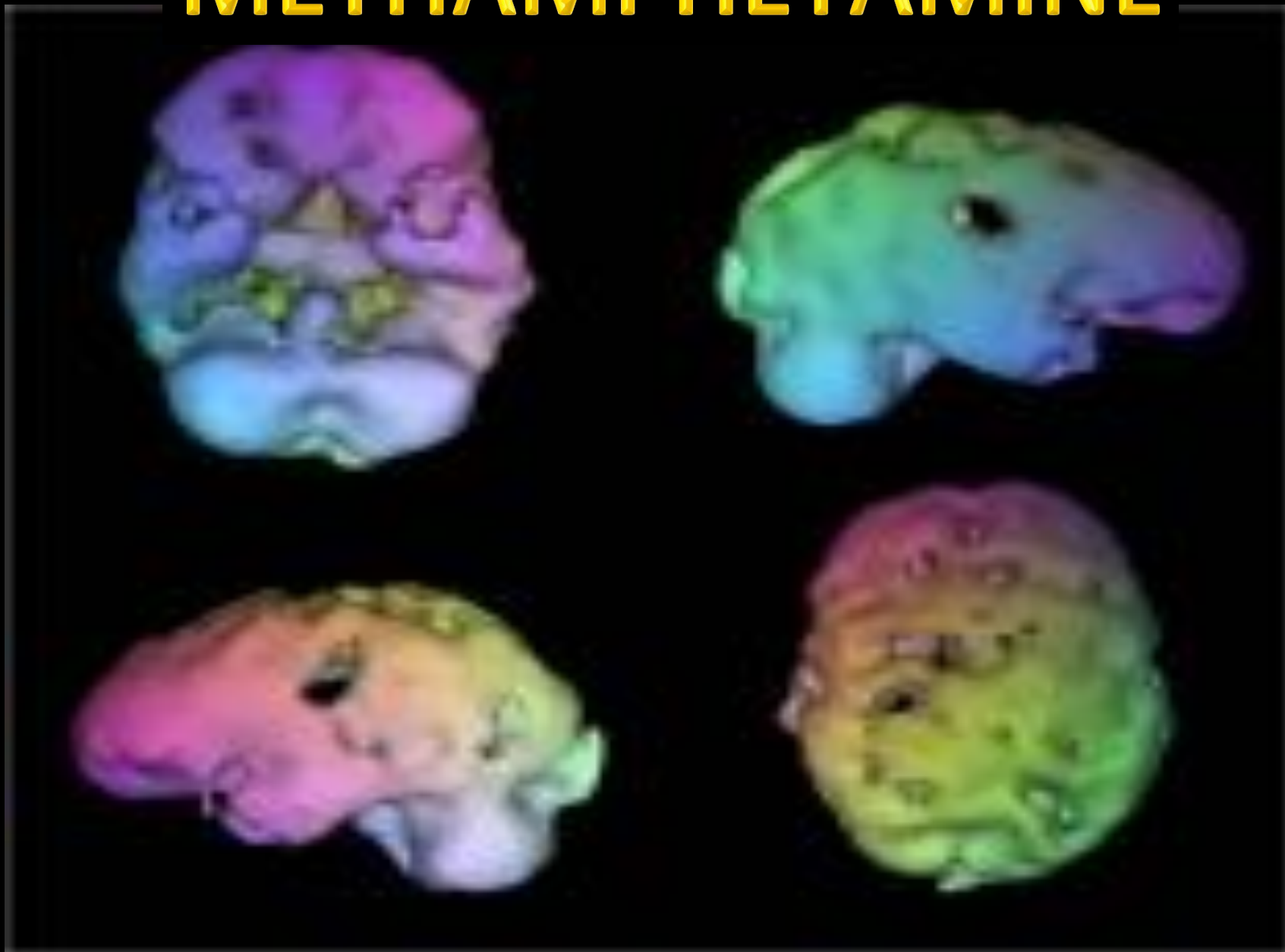
# HEROIN



# COCAINE



# METHAMPHETAMINE





# SOCIAL DRUGS





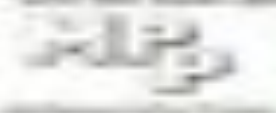
"Marijuana helps me relax, without affecting my athletic."

**Michael Phelps**

16 Times Olympic Gold Medalist

**Marijuana: Inspiring successful Americans since 1776.**

Over the last decade, marijuana has been legalized in 23 states.



**MONTANA**



**Montana**  
A Great Place to Live and Work

WORLD PICTURE EXCLUSIVE

# PHELPS GOES BONG

Olympic gold medal winner  
caught with cannabis pipe

14 OLYMPIC GOLD MEDALS  
37 WORLD RECORDS.  
2 AWESOME LUNGS.

Unlike heavy tobacco smokers, heavy marijuana smokers exhibit no destruction of the lung's small airways. That indicates that people who not develop emphysema from smoking marijuana.

For more information, visit [www.marijuana.com](http://www.marijuana.com)

Don't let the government fool you

LEONARD MARIJUANA

www.marijuana.com

## SMOKING MARIJUANA WASTES POTENTIAL

Smoking marijuana can cause  
respiratory problems and is  
addictive. It can also lead to  
mental health problems and  
impair judgment. For more  
information, visit [www.marijuana.com](http://www.marijuana.com)

WORLDWIDE MARIJUANA





# Social Drugs



National Study of  
Substance Use Trends  
Among NCAA College  
Student-Athletes

**Alcohol 83%**  
**MJ 22%**



# Pure Performance Project

John Underwood

Director,

American Athletic Institute



# Substance Use Categories

Alcohol

Marijuana

Amphetamines

Anabolic Steroids

Cigarettes

Snuff Tobacco

Cocaine

Ephedrine



# Rx drugs and Athletes



Although athletes are young and generally healthy, they use a variety of non-doping classified medicines to treat injuries, cure illnesses and obtain a competitive edge. Athletes and sports medicine physicians try to optimize the treatment of symptoms related to extreme training during an elite athlete's active career. According to several studies, the use of Rx medication is more frequent among elite athletes than in the general population.

# Substance Use

National Study of  
Substance Use Trends  
Among NCAA College  
Student-Athletes



1985

1997

2001

2005

2009

2012

The NCAA salutes

**440,000**

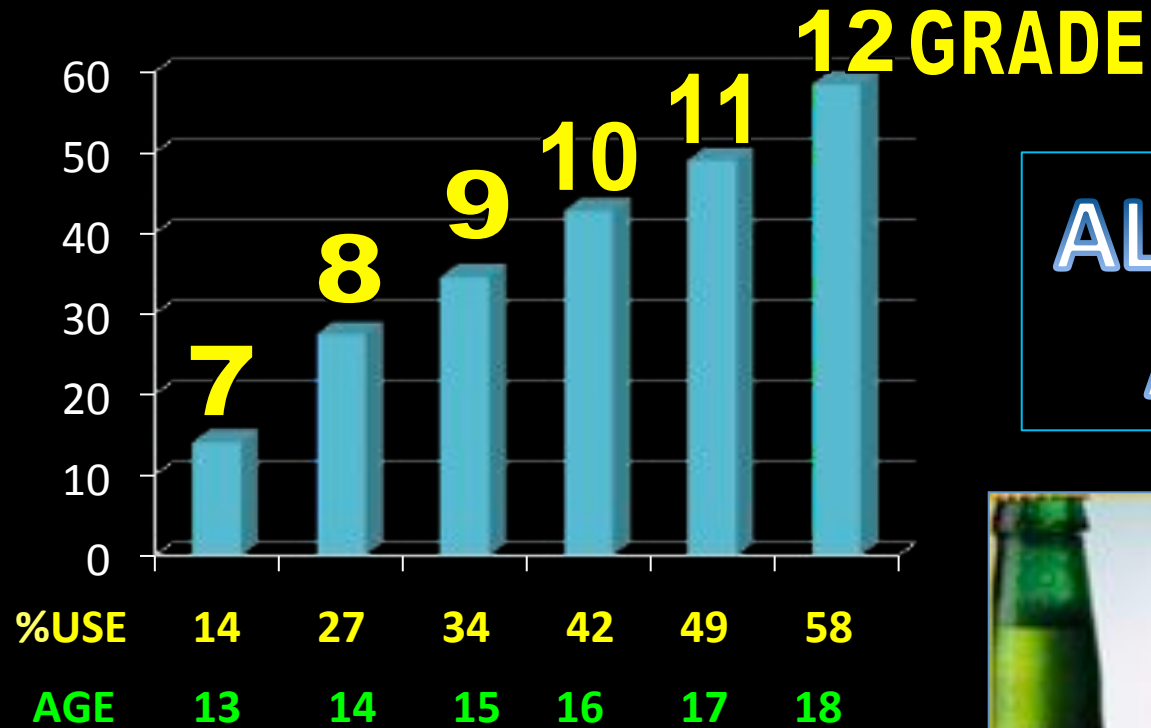
student-athletes

participating in

**23** sports at

**1,200** member institutions

## JR. ATHLETES REPORTING ALCOHOL USE DURING SPORT SEASON



**ALCOHOL USE  
ATHLETES**



**Middle School – High School**

## Junior Level

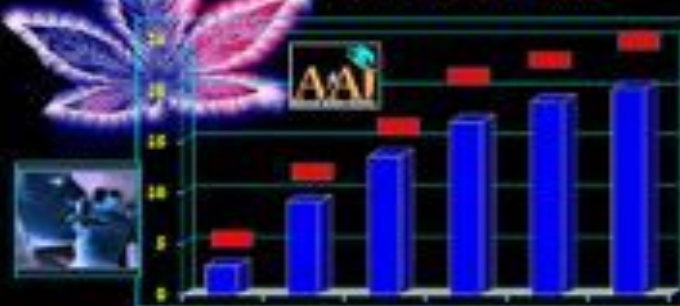
### Athlete Use of Marijuana

Age Grade % Using

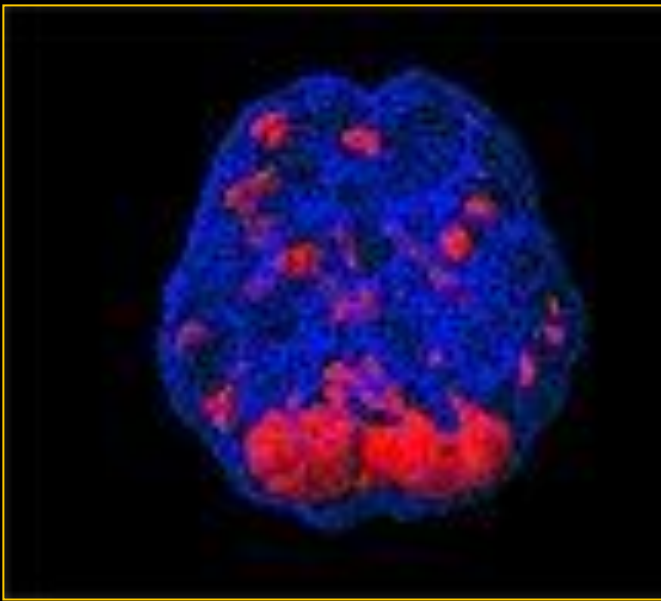
13	7	3%
14	8	9%
15	9	13%
16	10	17%
17	11	19%
18	12	20%



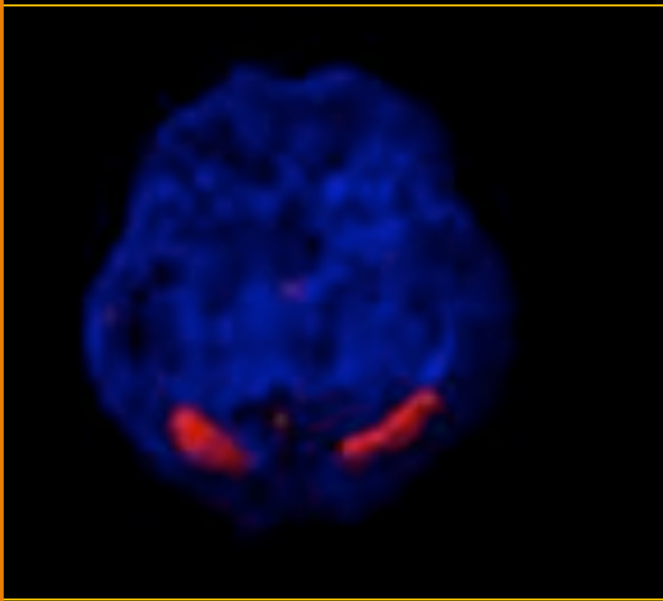
### MARIJUANA USE ATHLETES



# Brain Activity Alcohol



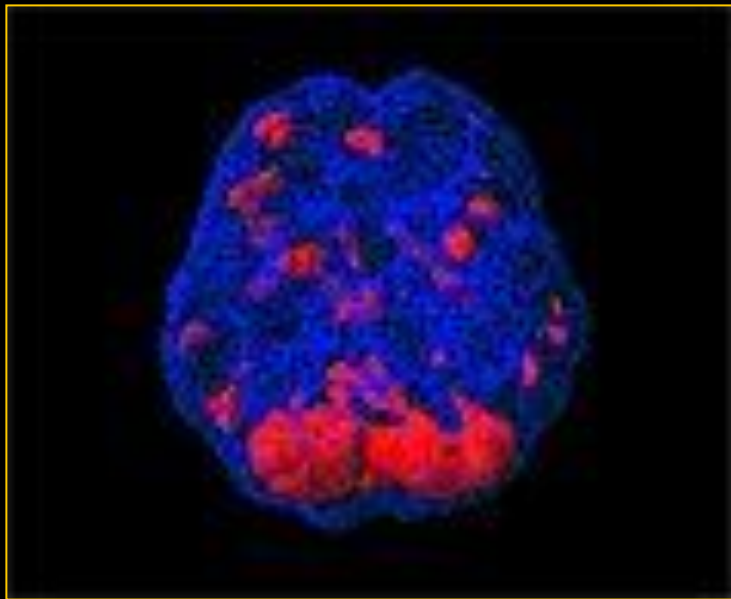
**Not under  
influence**



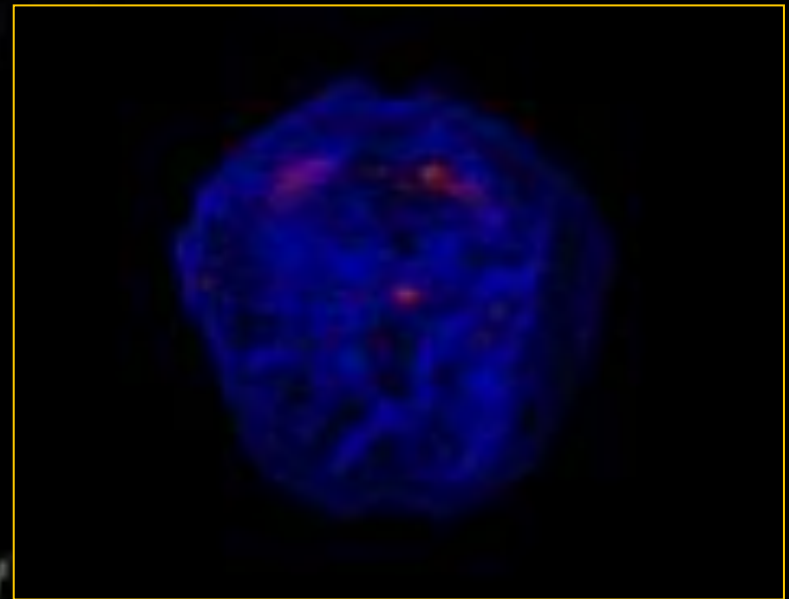
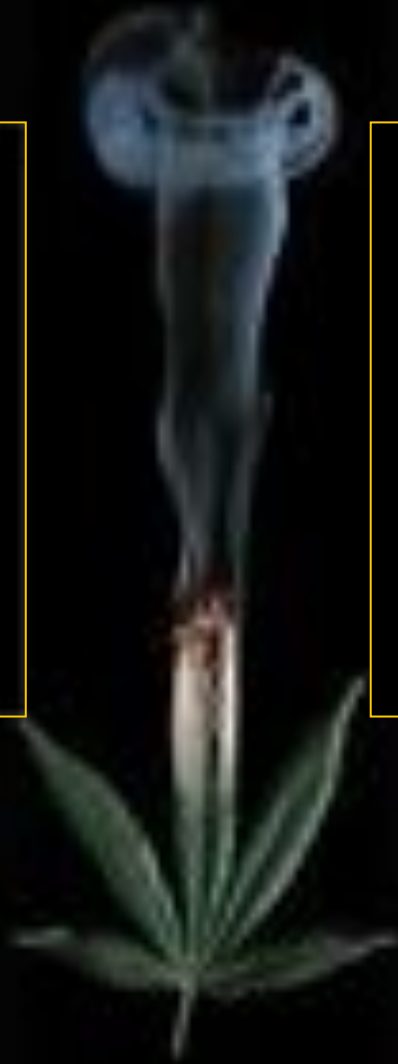
**Intoxicated**



# Brain Activity Marijuana



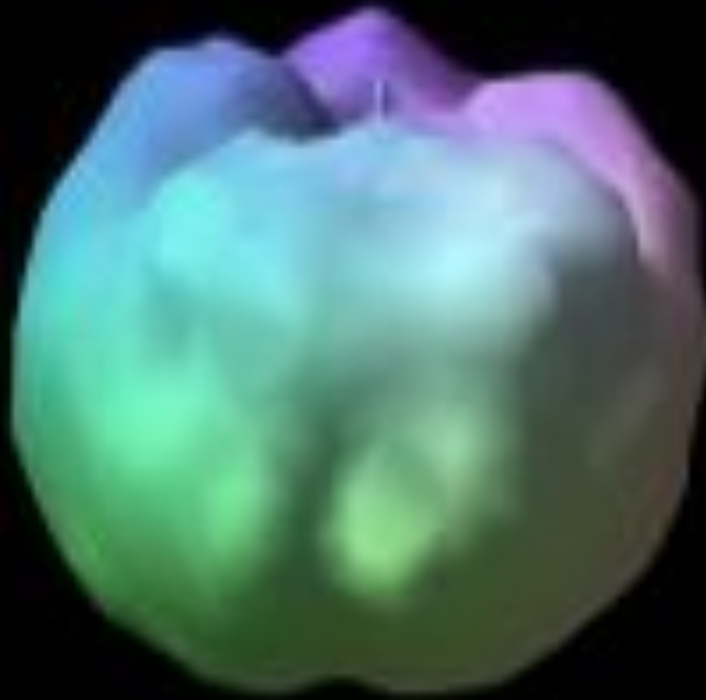
**Not under  
influence**



**Stoned**

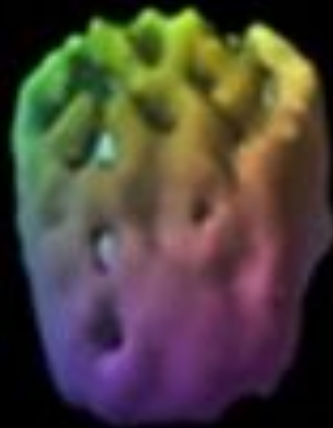
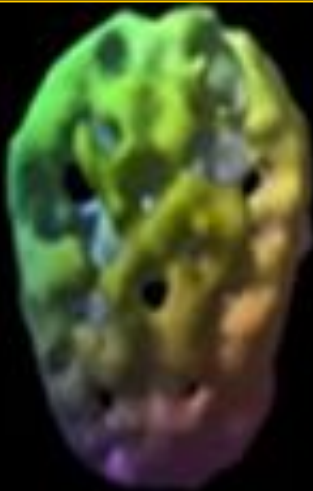
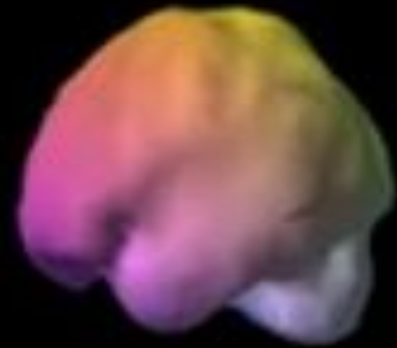
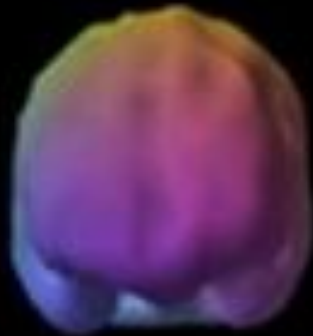
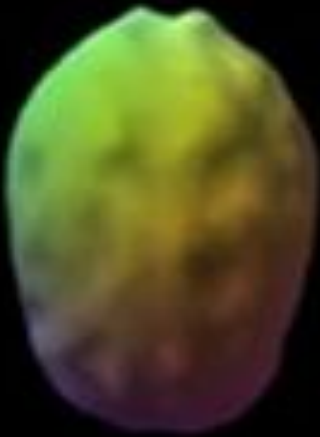


Healthy



Marijuana

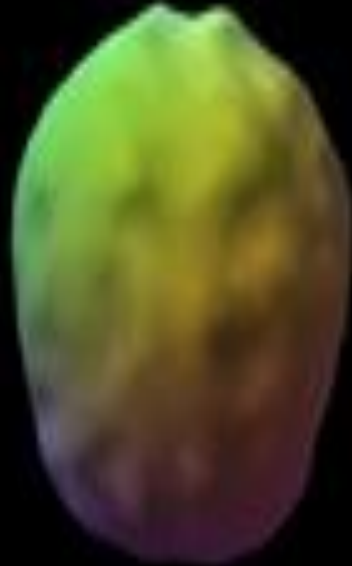




Take your chances

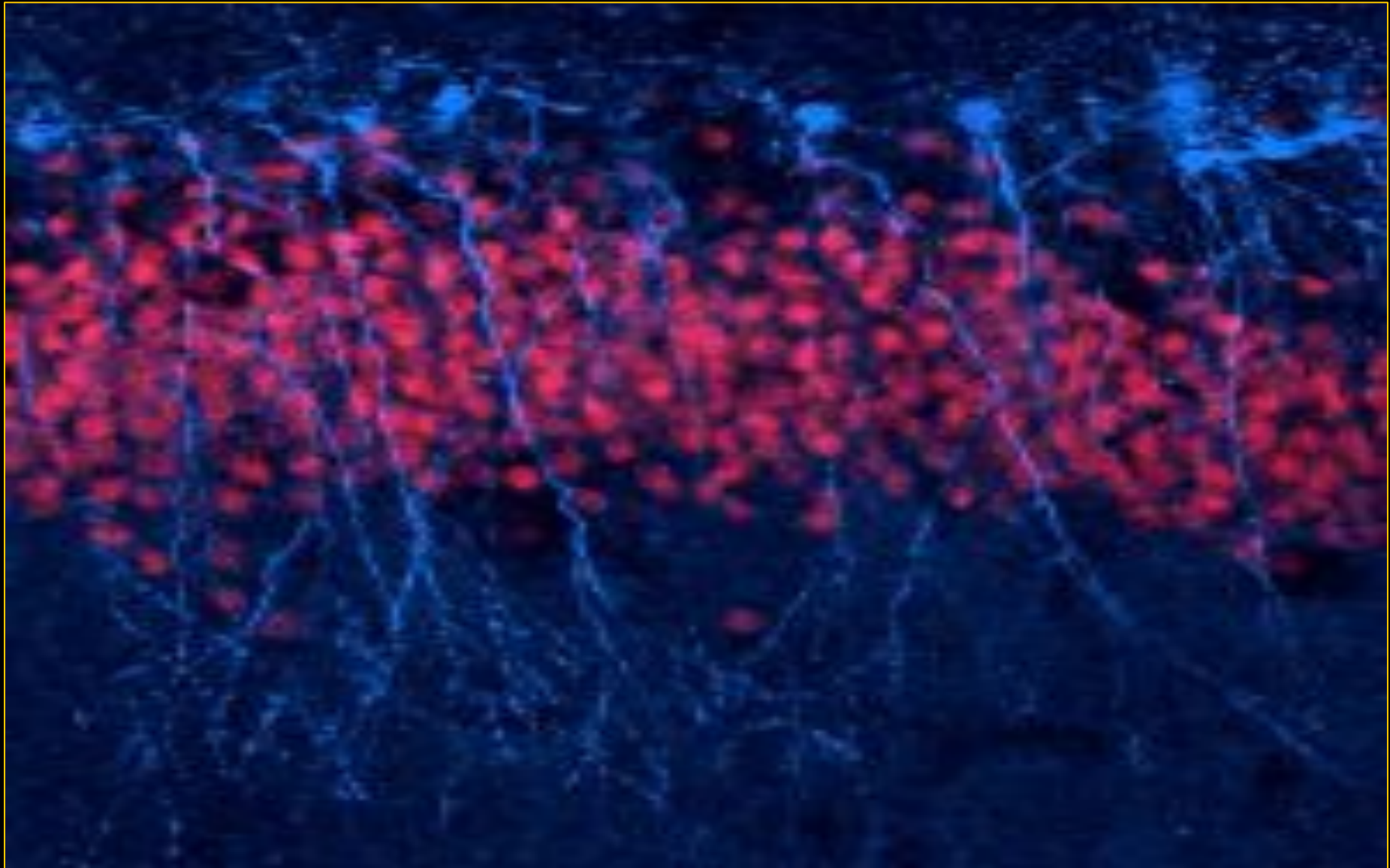


Alcohol no alcohol one year later



HEALTHY





Neuroplasticity new brain cells replace damaged areas



# Positives and Negatives

EVERY CHECK IN THIS COLUMN  
WILL HELP YOU MAXIMIZE  
YOUR PERFORMANCE:

- ✓ Elevate Blood Glucose
- ✓ Rested (8+ hours of sleep)
- ✓ **Post Training** Nutritional Recovery
- ✓ Non-weight Bearing
- ✓ Rest
- ✓ Refuel
- ✓ Rehydrate
- ✓ Sleep

Maximum Results for your effort!

A SINGLE CHECK IN THIS  
COLUMN AND IT IS ALL  
UNDONE

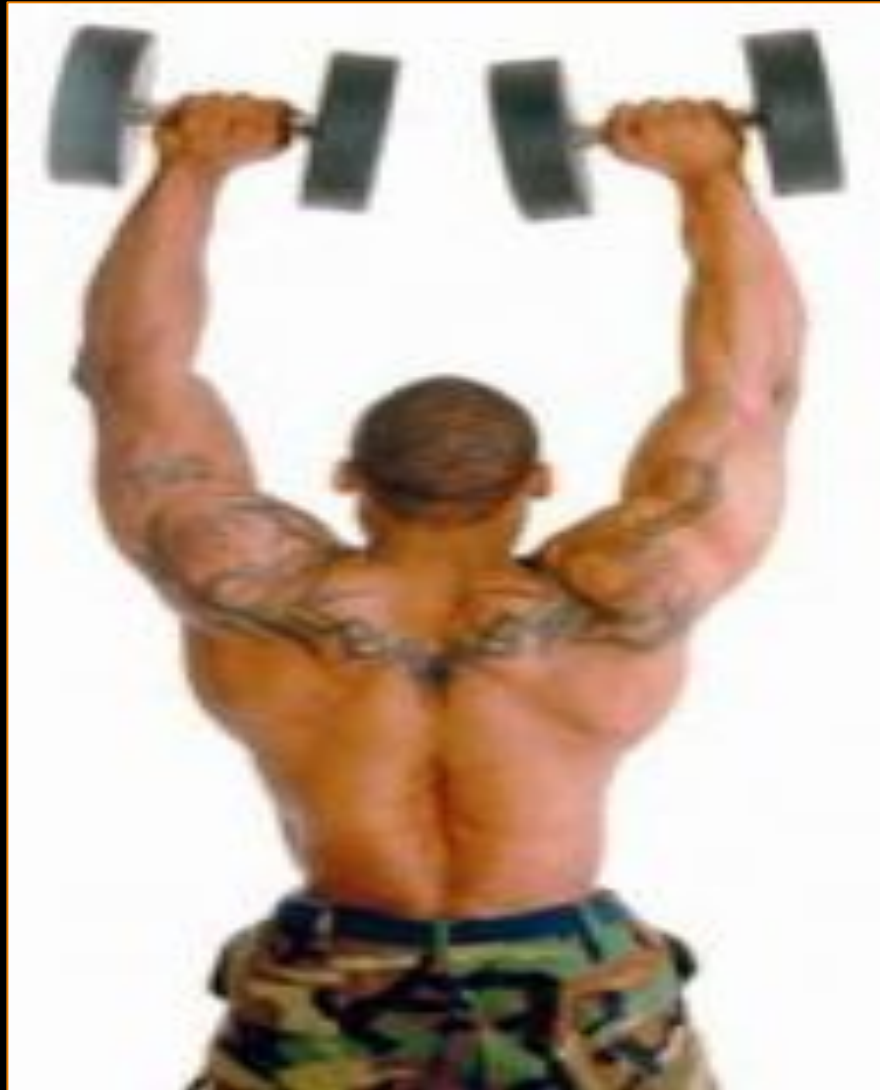
Marijuana  
✓ Alcohol





# ALCOHOL EFFECTS PHYSICAL/MENTAL





For 24 hours  
after heavy  
drinking, it is  
impossible to  
have any  
training effect  
take place

**24 HOURS**

**DEFICITS**





There are  
effects from  
any amount of  
alcohol.  
Even one  
drink!

**PHYSICAL  
COGNITIVE**



The hangover is just the beginning...



M T W R F S S





**ALCOHOL UNKNOWN**

Alcohol is converted to acetaldehyde by the enzyme alcohol dehydrogenase, and then from acetaldehyde to acetic acid by the enzyme acetaldehyde dehydrogenase. Acetaldehyde (potentially) is between 10 and 30 times more toxic than alcohol itself.



Life <sup>of an</sup>  
**Athlete**



10x 20x 30x

ALCOHOL > ACETALDEHYDE



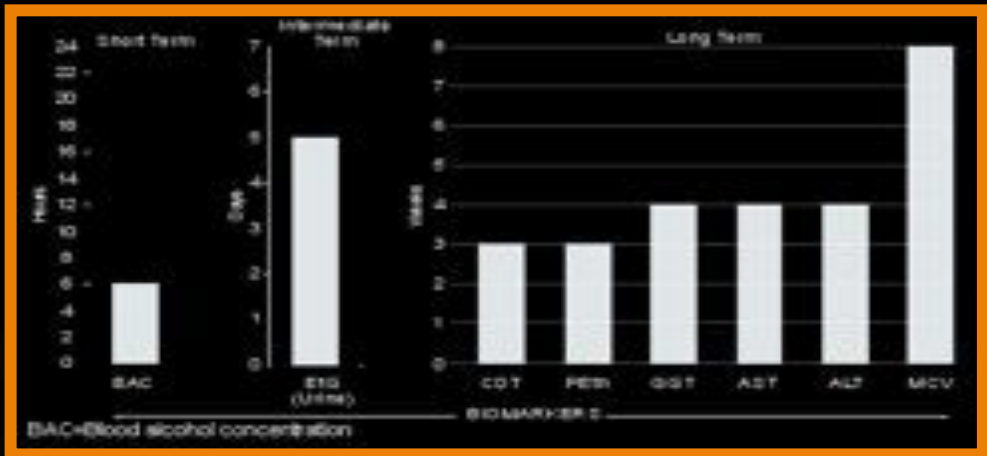


The smallest of  
measures

IN URINE



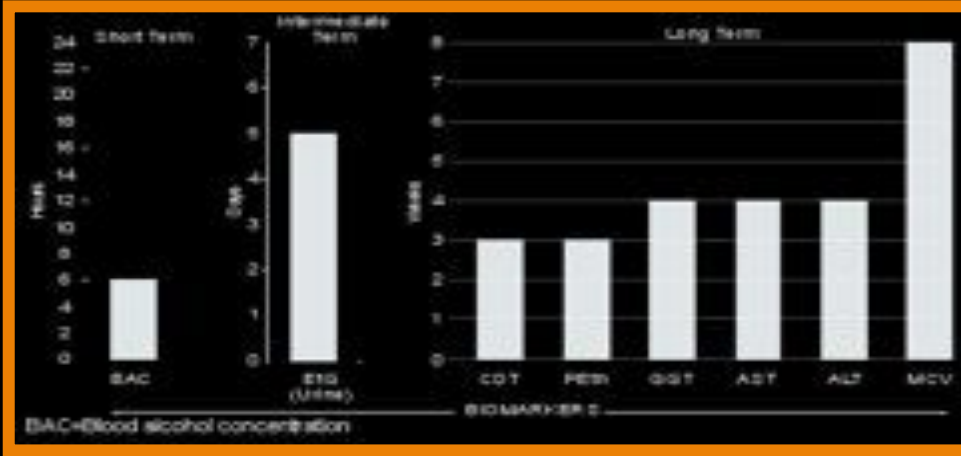
(0.02%) non-oxidative pathway produces ethyl glucuronide (EtG), which is excreted in the urine.



## Windows of Assessment for Various Alcohol Biomarkers

**4-5 DAYS**  
**80 HRS.**





IN BLOOD

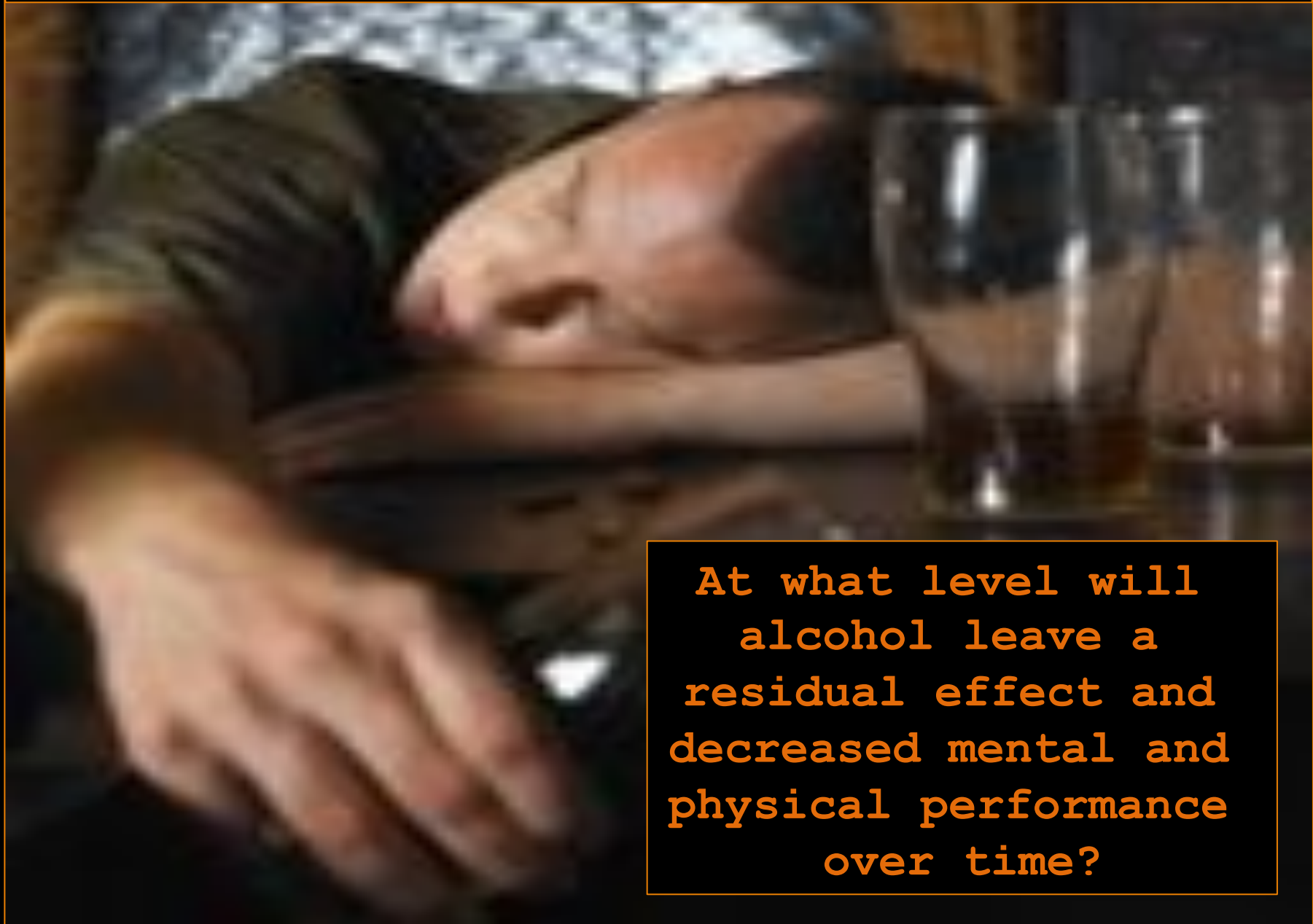
3-8 WEEKS



The more you drink the more you impair brain, body and CNS function.



## DECREASED MENTAL PHYSICAL PERFORMANCE



At what level will  
alcohol leave a  
residual effect and  
decreased mental and  
physical performance  
over time?



Effects of alcohol begin at 1-2 drinks  
Effects increase dramatically at 3-4 drinks  
Effects at 5-6 drinks have serious residual effect

# RESIDUAL EFFECTS

RED GREEN BLUE 12 35 50



Minimal

Residual





The residual effect of alcohol or a hangover has been shown to reduce performance by an average of 11.4% in elite athlete populations.

<11.4%

PERFORMANCE POTENTIAL



# Muscle Function



Ethanol is a very small molecule. Because of its size and polarity (charge), it can readily enter (diffuse without the concomitant expenditure of energy in the form of ATP) through the cell membrane of skeletal muscle.

In the process, ethanol can disrupt the molecular configuration of the fatty acyl groups of the phospholipids of the skeletal muscle. Ultimately, this could interfere with several processes including the entry of calcium ions into the nerve terminal or an increased binding of calcium to the sarcoplasmic reticulum of the muscle.

Calcium is the cation (a positively charged ion) which is involved in the control of the rate of release of neurotransmitter into the synapse (the area between the nerve and the muscle) and plays the most important role in muscle contraction and relaxation.

Thus in summary, alcohol is not a fuel for muscle contraction and alters fuel metabolism to increase lactate production and decrease lactate degradation. Furthermore, disrupts the molecular configuration of skeletal muscle and compromises its ability to perform muscle contraction. ( Balon/Underwood 2004)





Alcohol injected right on the nerve directly stops off the fat from that location and slows conduction there. Multiple speeding impulses pile up and come through as one single impulse. So a stream of impulses such as:

[illegible]

Engineers call that a low pass filter.



When a muscle gets hit with a single "go" it responds. When it gets hit with a barrage of gopogopogopoging, it gets thrown into tetany, a rigid hard to undo contractile state. Worse, it screams for help over feed back circuits which (in specificity) are mistakenly linked into the motor circuits by reflex spinal pathways.

Slowing certain nerves in the loop can drop the recruitment of the reflex mechanisms which get drawn into the loop from further and further away in the spinal pathways as the recruitment gets worse.

# Misfiring of muscle impulses





Cardiac Output  
Stroke Volume  
Cardiac Arrhythmias

**HEART FUNCTION**



$< O_2$   
 $> CO_2$   
 $< VE$



# LUNG FUNCTION



# Blood Glucose Levels

The body has trouble making more glucose because it is expending its energy metabolizing the alcohol. Both of these effects of alcohol can cause severe hypoglycemia low blood glucose levels for 6 to 36 hours after a binge drinking episode.





.08

.07

.06

.05

.04

.03

.02

.01

Alcohol consumption produced adverse effects on visual functions, producing a loss of 84 binocular fields. In general, the majority of impairment were characterized as a loss of peripheral vision. Many different behavioral functions were included in this category, including visual acuity, contrast sensitivity, eye movements and visual field extent. These results appear not to be affected by alcohol intake of 0.05 and 0.07, a finding which is consistent with earlier studies. On the other hand, contrast sensitivity was found to decrease significantly at alcohol intakes of 0.05 and 0.07, and fields of peripheral vision were impaired by alcohol at 0.05 and 0.07. Moreover, as previously, for example, found that subjective coordination of oculomotor function was significantly affected at 0.05 and 0.07.



## ALCOHOL AND VISION



# Alcohol and Vision

NEWMAN and FLETCHER, who measured seven aspects of visual function in 50 subjects before and after alcohol administration. Blood alcohol levels ranged from 58 to 218 mg. The tests and results follow:

Decreased levels were seen in:

Sensitivity to Light	
Target Tracking	Glare Recovery
Visual Acuity	Eye Coordination
Distance Judgement	Depth Perception
Lateral Visual Field	Glare Resistance

Ability to:

Track and follow moving objects...  
Determine depth between objects...  
Determine the speed or velocity of a travelling object...

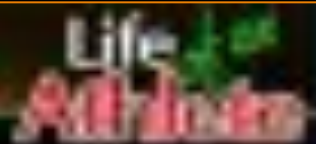
Open your eyes!





**TRAINING HORMONES**





# TESTOSTERONE

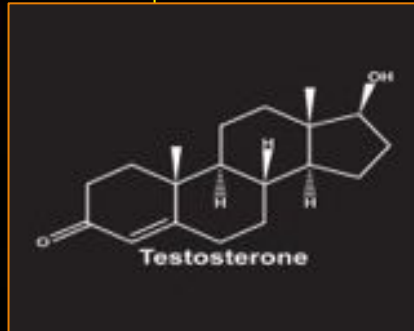
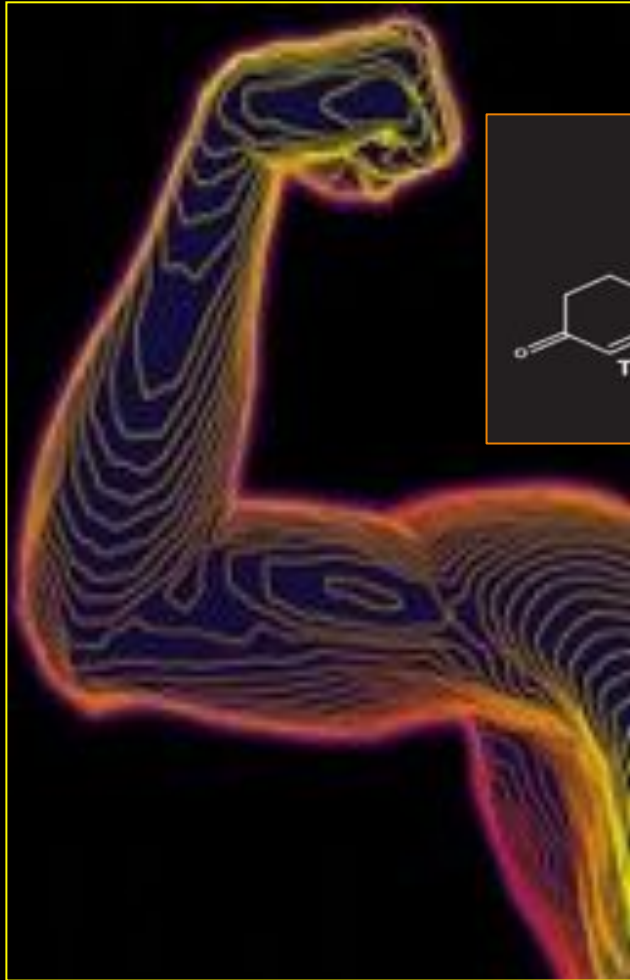
Studies of athletes abstinent from alcohol have shown that alcohol directly suppresses testosterone levels.

The more you drink, the more it gets.

And it's not just at the time you are drinking.

The biggest hit comes later, and spills into the following days....





Heavy maximal level training followed by excessive alcohol consumption can result in hormonal disruptions for up to 96 hours (4 days)

TRAINING EFFECT  
RECOVERY  
PERFORMANCE

THE 96 HOUR HOLE



(12-20 hours after the start of drinking) the testosterone level was only about half what it was...

It happens fast



**TESTOSTERONE**



Some males who drink heavily & regularly have testosterone levels similar to female levels.

# Alcohol And Testosterone



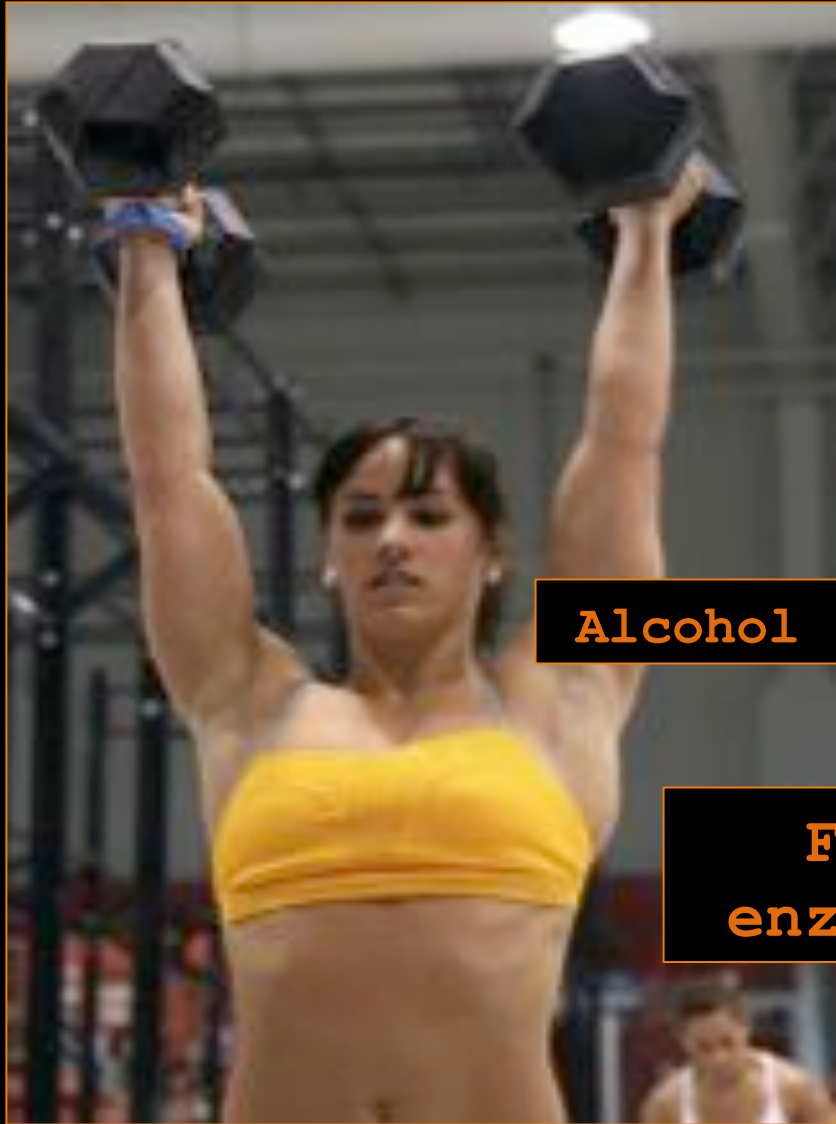
Females have 1/10th  
of the training  
hormones of men.

Training effect is  
much more fragile



Female Training Effect





Alcohol stays in the female body longer

Females have less of the  
enzymes to breakdown alcohol

Alcohol>affects on females



# Alcohol and Sickness

Life <sup>of</sup>  
Athlete



The impairment of cellular  
immune response can be  
attributed to acute alcohol use...

## Sickness





HGH

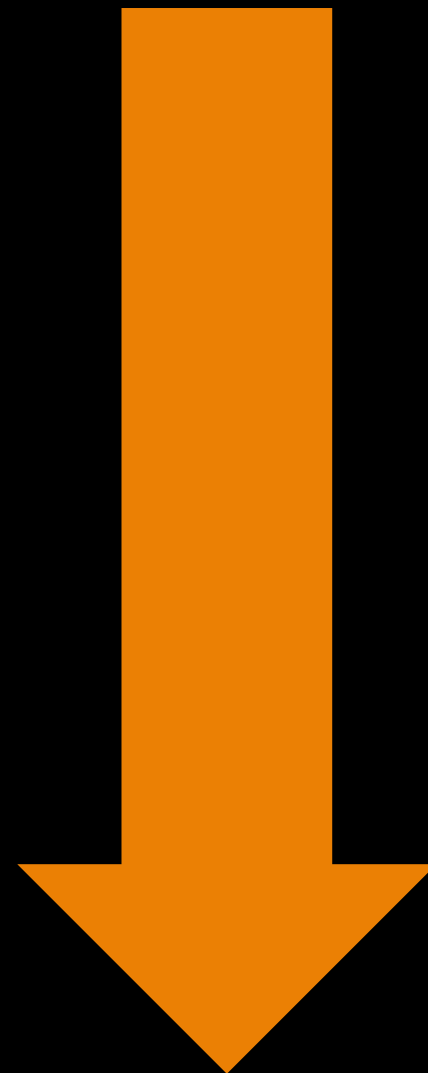
Maintains muscle mass  
Repairs muscle fiber  
Fat metabolism  
Carbohydrate metabolism



70%

Human Growth Hormone





**STRENGTH/POWER**





<11%

EXPLOSIVE POWER





< 8%

POWER ENDURANCE



# Drunks Can't JUMP



## Static CM Jumps

Subject	Height (cm)	Static Jump (cm)	Dynamic Jump (cm)	Static Jump (cm)	Dynamic Jump (cm)
1	175.0	15.0	15.0	15.0	15.0
2	175.0	15.0	15.0	15.0	15.0
3	175.0	15.0	15.0	15.0	15.0
4	175.0	15.0	15.0	15.0	15.0
5	175.0	15.0	15.0	15.0	15.0
6	175.0	15.0	15.0	15.0	15.0
7	175.0	15.0	15.0	15.0	15.0
8	175.0	15.0	15.0	15.0	15.0
9	175.0	15.0	15.0	15.0	15.0
10	175.0	15.0	15.0	15.0	15.0
11	175.0	15.0	15.0	15.0	15.0
12	175.0	15.0	15.0	15.0	15.0
13	175.0	15.0	15.0	15.0	15.0



Static Jump



Dynamic Jump

7 of 13  
subjects >

This is data on 13 subjects measuring static jump and dynamic jump at two consecutive days, with and without alcohol. The subjects were measured before and after alcohol consumption. Alcohol levels were 10-15% of dynamic jump prior to the first test. The alcohol level was reduced to 5% after the first test. Dynamic jump was reduced in 7 of 13 subjects. (Source: [1])



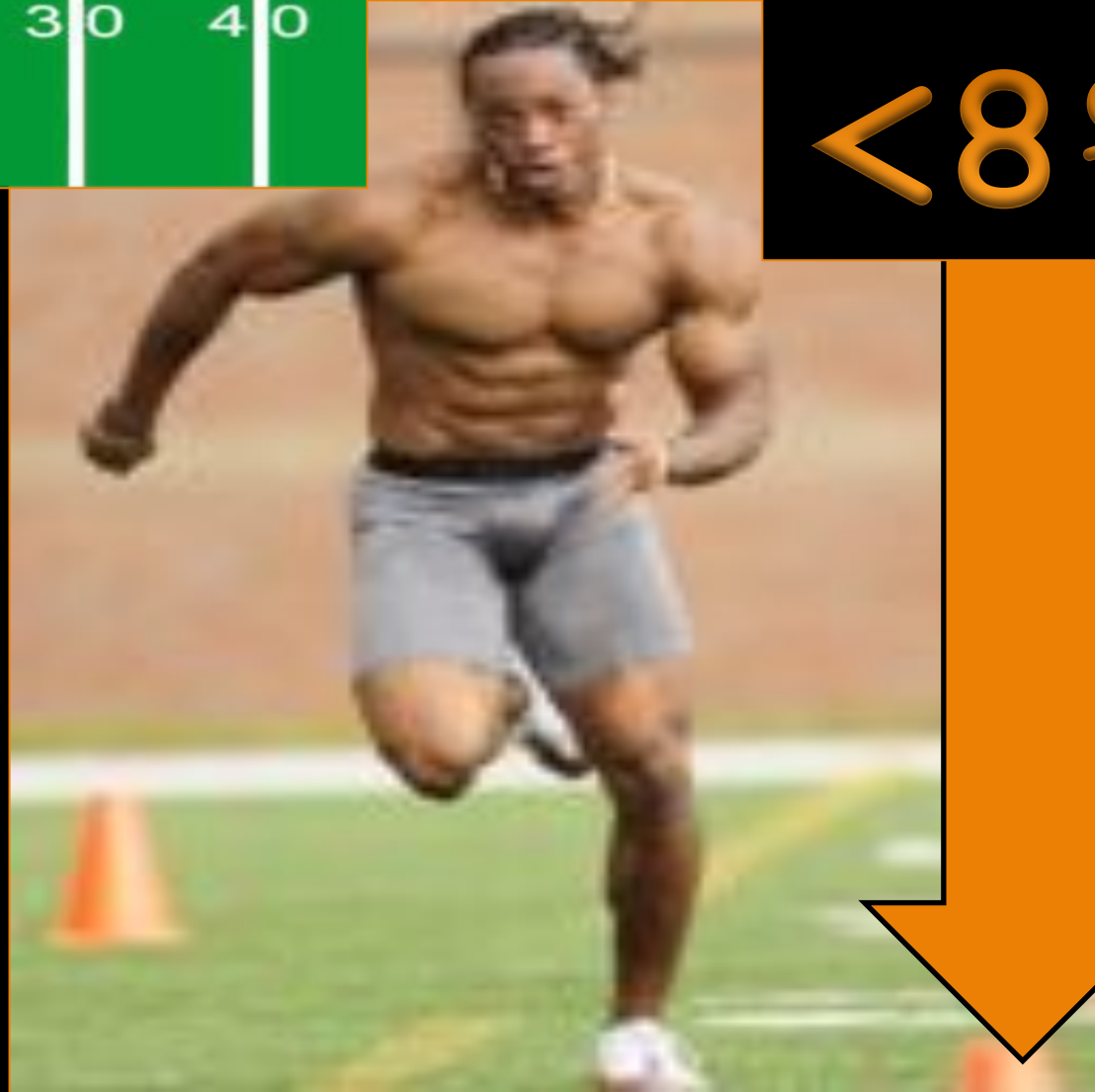


< 6%



ACCELERATION SPEED





< 8%



START UP SPEED



0-5 yds.



< 8%

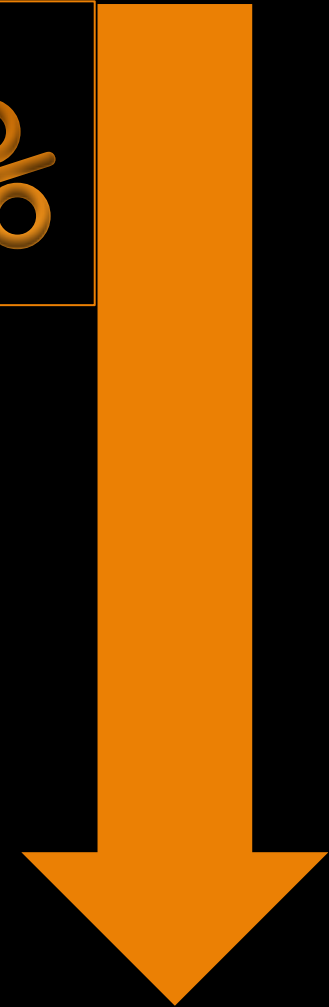
LATERAL SPEED





<6.96%

ENDURANCE



A close-up photograph of a person's midsection, showing their hand pinching a fold of skin and fat on their abdomen. The background is a solid dark blue.

# **FAT BURNING DECREASED**

**Alcohol  
greatly  
affects the  
amount of fat  
your body can  
and will burn  
for energy!**

**Just a mere 24g of alcohol consumption showed whole-body  
fat oxidation (the rate at which your body burns fat)  
decreased by 73%!**





1X DRUNK = 14 DAYS  
LOST TRAINING EFFECT

American Athletic Institute has studied the impact of alcohol on condition in elite athletes. Impact has shown significant projections in lost physiological condition that correlates to as much as 14 days of lost training effect...for each time drunk...

WASTING YOUR TIME



# Throwing away your hard work?



one night of drinking  
wipes out 2 weeks of training

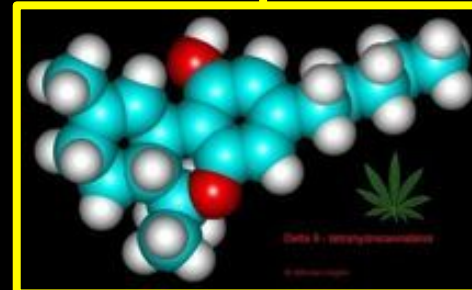
American College of Sports Medicine, 2000



American College of Sports Medicine

1996-2000 American College of Sports Medicine

www.acsm.org



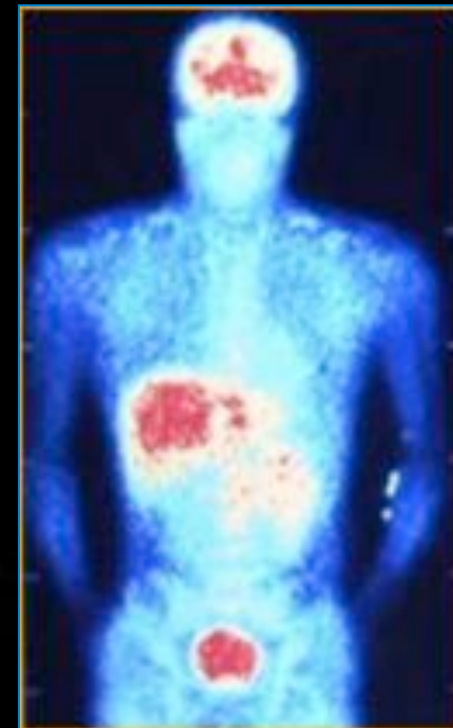
# The Effects of Marijuana on High Level Mental and Physical Performance

John G. Underwood  
Director American Athletic Institute

Life of  
Athletes



Global Athlete  
**MARIJUANA**  
Project



THC Deposit Sites

# Education



NCAA study released in January, 22.6 percent of athletes smoke weed...

College football players (26.7 percent) ranked the highest among major sports.

About half the team smokes, he estimates. "It's a team thing."

# Write articles Create Awareness

## ATHLETE LIFESTYLE ISSUES





A recent study found that athletes claimed smoking marijuana prior to a competition helps them focus...

# FOCUS

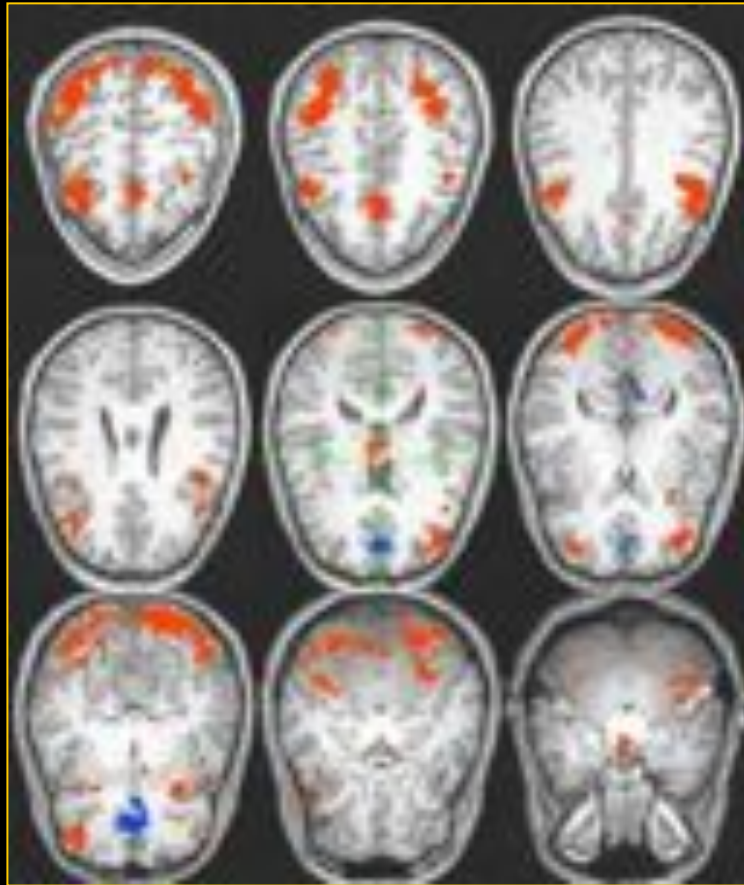




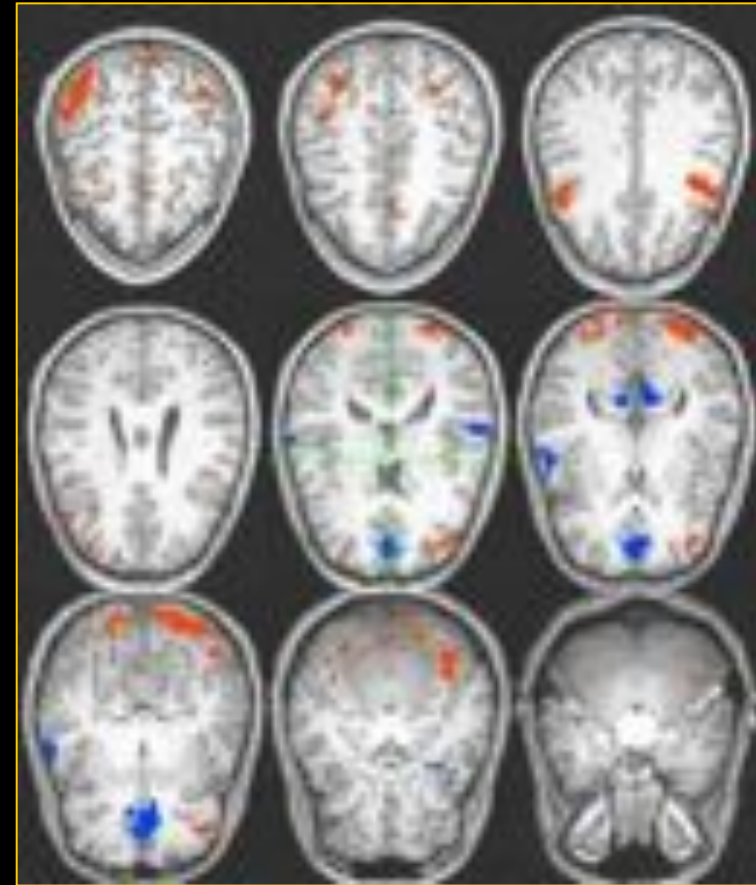
What research has been done worldwide that we can give our athletes to dispel this perception?

Effects of THC (1 mg) on activation on concept reaction to task

# Reaction to task formation



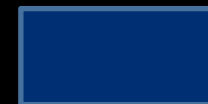
**Before**



**After**



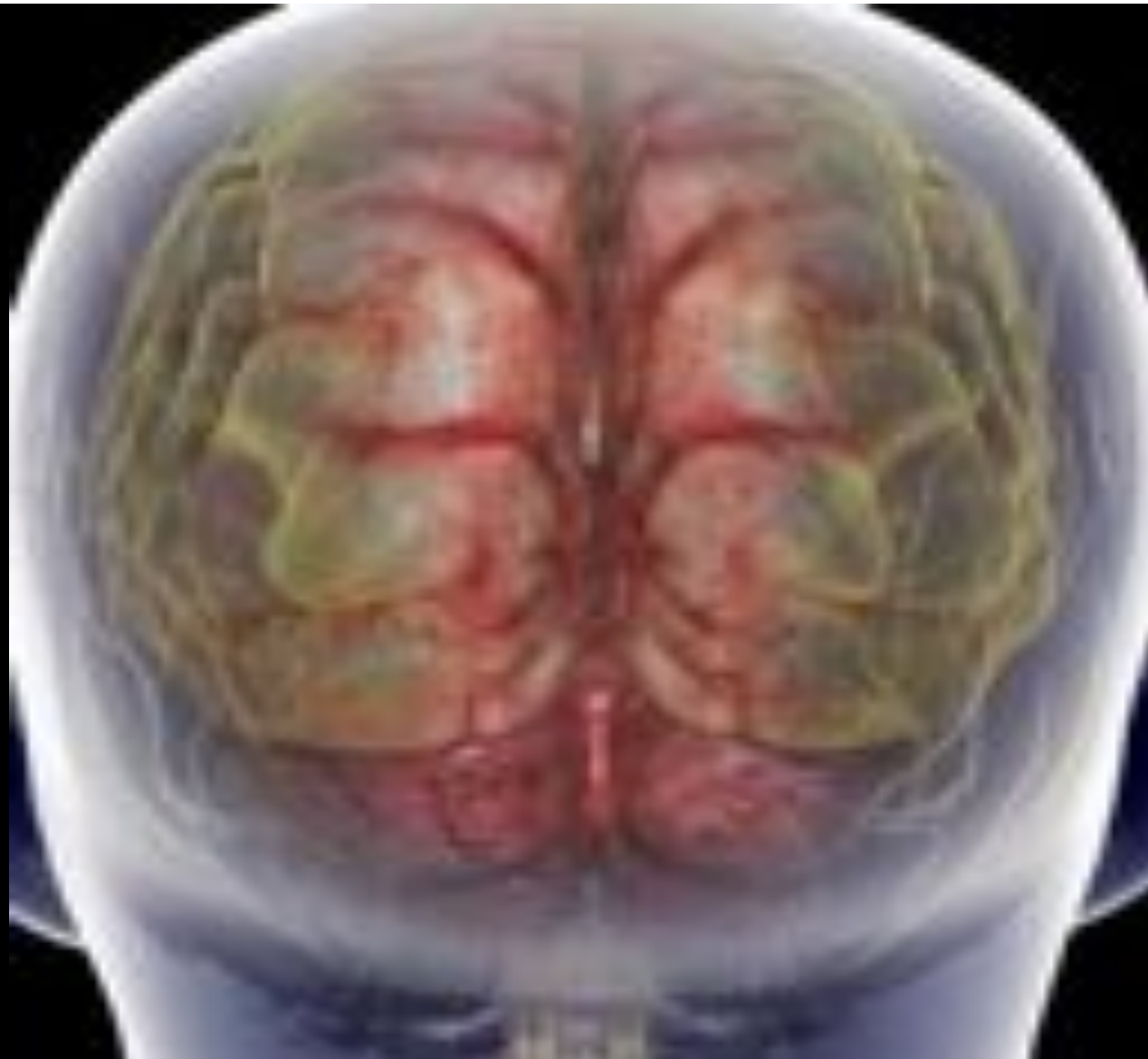
Oranges represent positive and blues negative activation



B

R

A



THC attaches to receptors in the brain and impacts learning, memory, reaction, movement and coordination.

N



# Receptors

There are membranes of particular nerve cells in the brain that have special protein receptors called, cannabinoid receptors, that bind with the THC. When the THC binds to these nerve receptors, a series of chemical reactions occur that alter the function of those nerve cells.

# Deposit Sites



NIDA

# Cannabinoid Receptors *'hot-spots'*



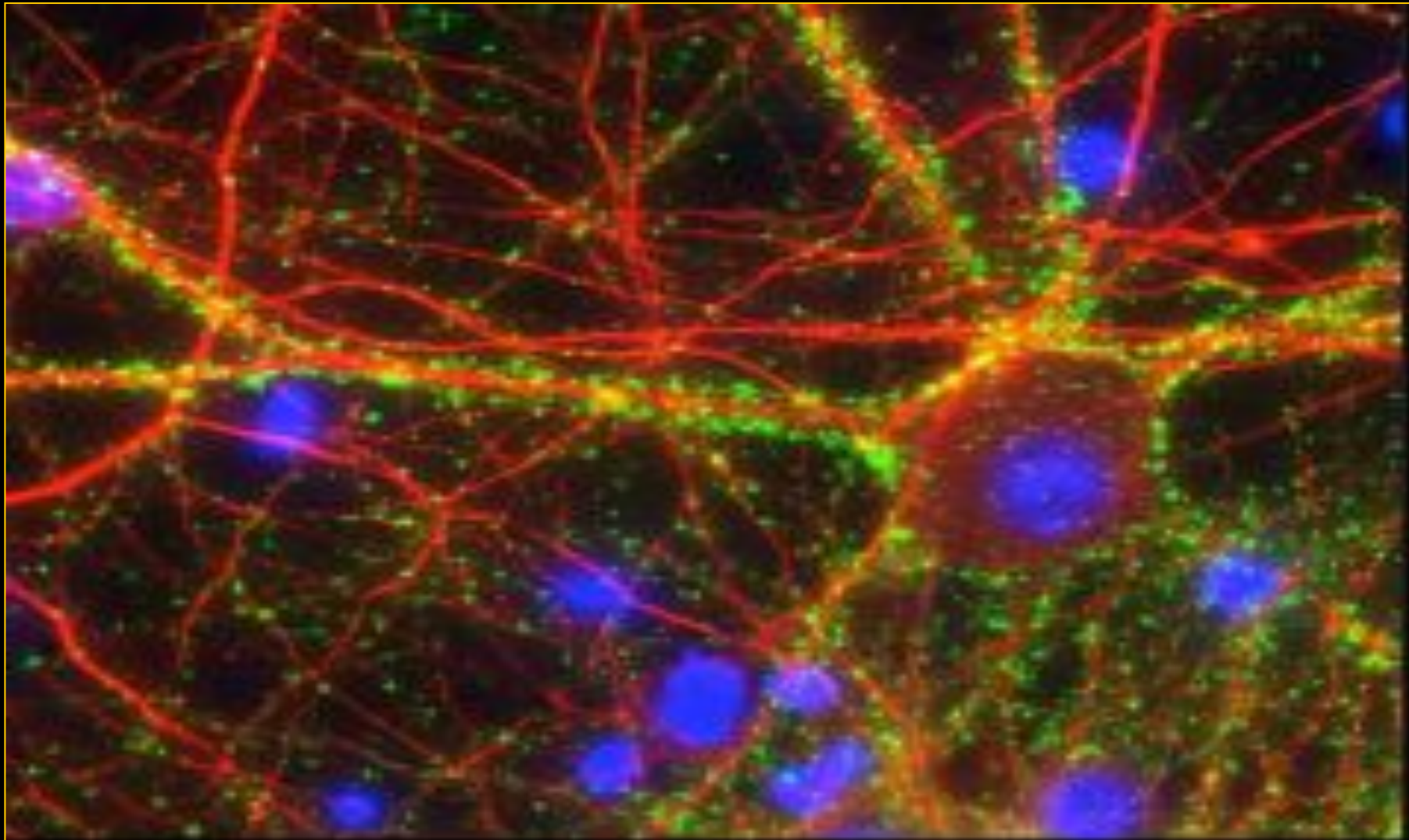
MRI scan of cellular cannabinoid reception.  
(Image © BBC 2009 -

*Brain*  
*Liver*  
*Pancreas*  
*Kidney*  
*Skin*  
*Prostate*  
*Cervix*  
*Testes*

B

O

D



**THC bound to receptor sites**

# **Cannabinoid Receptors in Brain**



**memory**

**cognition**

**reward**

**sensory perception**

**emotions**

**motor control**

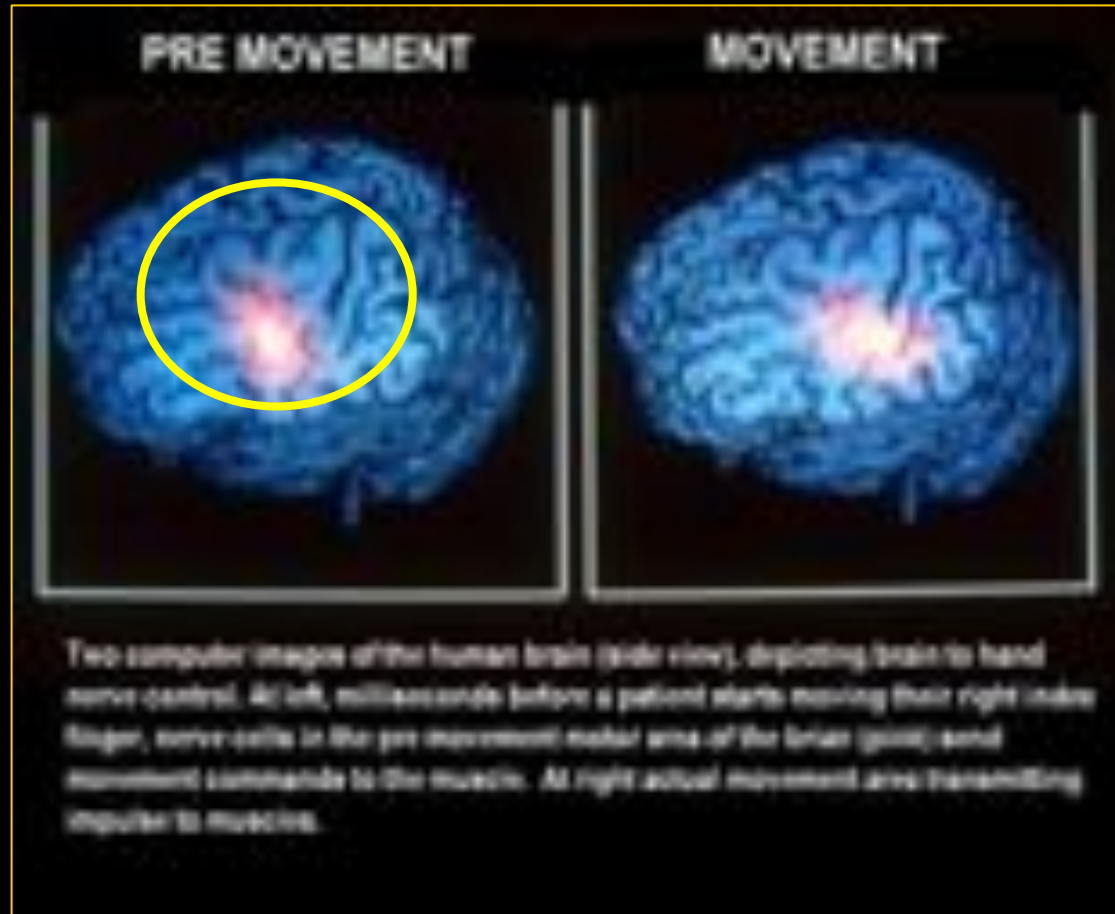
**movement memory**

**coordination**

# Pre Movement-Movement



LOCATOR



# Human Movement



Initiation of impulses for  
movement during finger  
tapping





# MARIJUANA SKILL IMPAIRMENT



**NON USER**  
**SIMPLE HAND SKILL**

Skill  
Recall  
Area



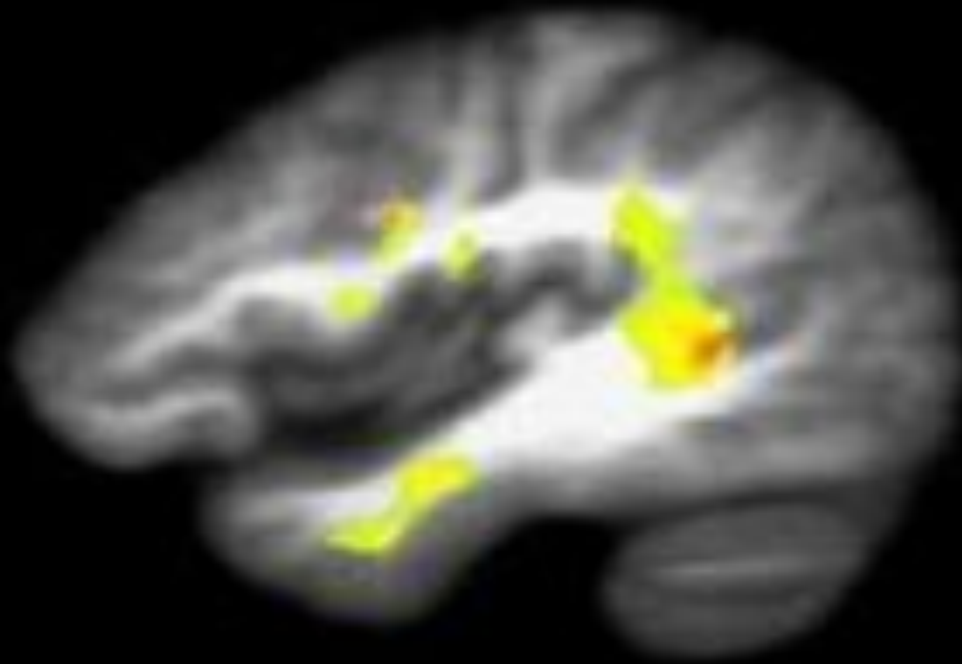
**MARIJUANA USER**  
**SIMPLE HAND SKILL**

Note: Subject not under influence during scan.

## POT OR NOT? YOUR CHOICE YOUR GAME

# White matter matters

THINK



COMMUNICATE

CANNABINOIDS  
INCREASE THE SECRETION  
OF SOMATOSTATIN

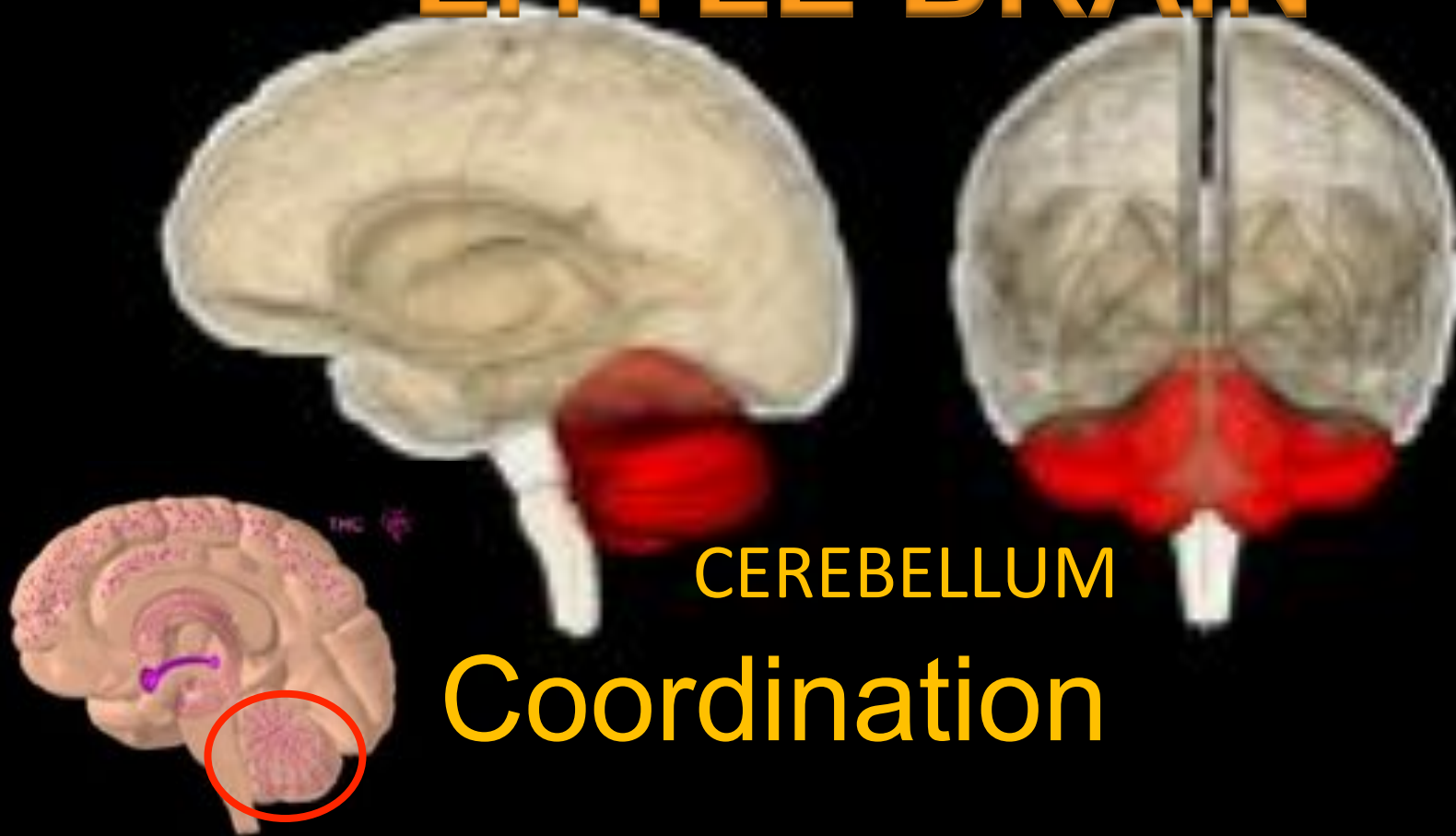
The hypothalamus also  
secretes a chemical called  
Somatostatin (SS). When it  
releases Somatostatin it  
travels to the pituitary  
which inhibits or stops  
the release of growth  
hormone into the blood.



SOMATOSTATIN BLOCKS HGH

Drugs Athlete Used Project

# LITTLE BRAIN

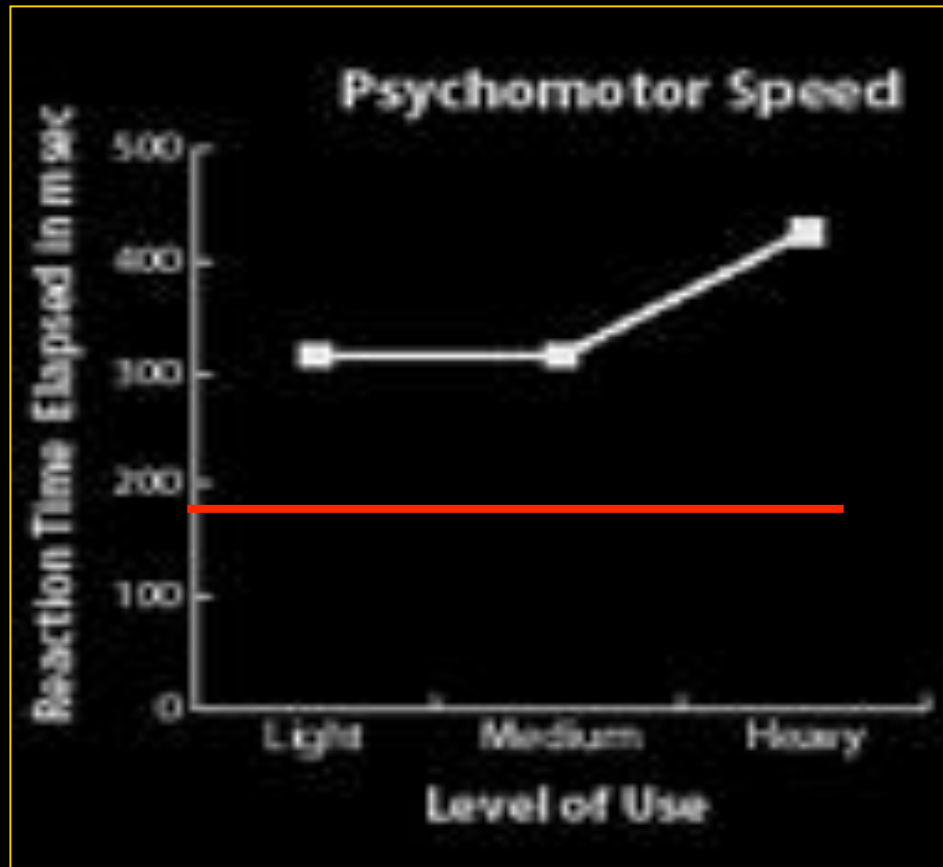


CEREBELLUM

## Coordination

- Equilibrium
- Balance
- Muscle tone
- Ability to perform rapid alternating movements

# WEED and REACTION

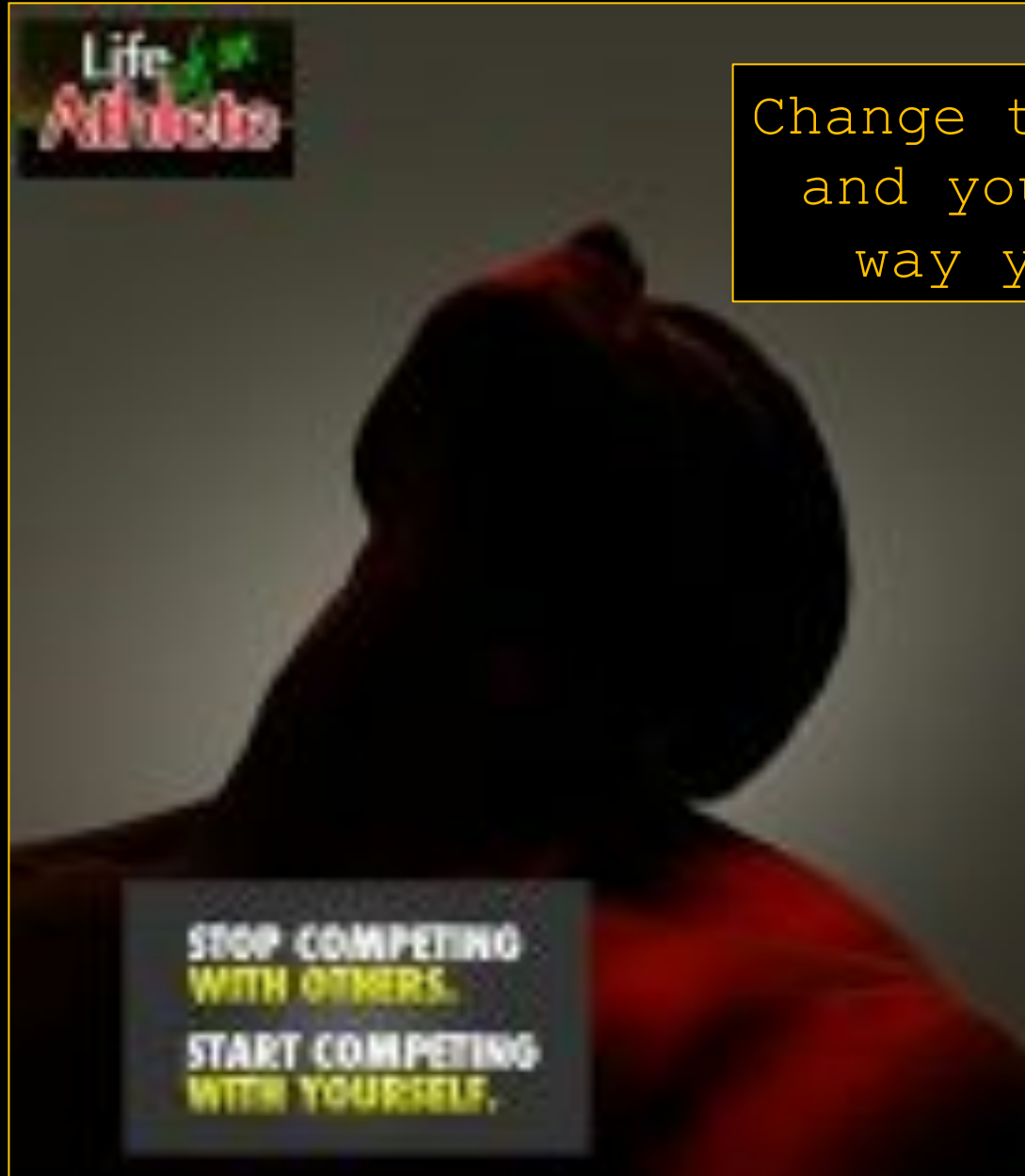


Average in the  
.300-.450msec range.



\*Highly functional trained athletes  
have faster reaction times





Change the way you live  
and you will change the  
way you can compete...

