Topic 6: Sports

- We used to have a very different attitude about doping in sports
- Our attitude now:
    - Ben Johnson
        - Won gold but then tested positive for performance enhancing drugs
        - This started the war against drugs in sports
    - Stanozolol
        - John Manson (Canadian) invented the drug Ben Johnson used
    - Mark McGwire
        - Broke the single season home run records
        - Took something that you could get at the drug store so his record is tainted
    - Barry Bonds
        - Also broke the home run record
        - Rumors that he used drugs but there has never been any evidence
        - So his team declined to renew his contract
    - Marion Jones
        - Track and field gold medals
        - Her husband was involved in a scandal and she was a witness in the trial
            - Testified that she did not use drugs
        - Evidence had been brought against her that she did and she admitted to it
        - Was stripped of her medals and sent to prison
- In greece athletes were encouraged to use performance enhancing drugs
    - They were encouraged to just be a good as they possibly can
    - Took herbs and potions
        - Kept them secret so their competitors would not be able to find them
- Zulu warrior took performance enhancing drugs before battle
    - Was an alcoholic drink with some mild hallucinogens
    - Was called dope
    - Was brought back to england and used in battle but also sporting events
        - Was used on race horses
            - Would dope the good horses that people bet on so they would get sick and loose
            - Then the bad horses that people did not bet on would win
- Cycling was the first human event to be associated with doping
    - These contained:
        - Caffeine
        - Cocaine
        - Alcohol
        - Nitroglycerine
        - Strychnine (the only useful one)
- St Louis Olympics 1904
    - The marathon
        - Conditions
            - Temps above 40
            - 100% humidity

            - Dirt roads
        - Athletes were not allowed water it was believed that it would cause cramps and was not a good idea
        - Thomas hicks collapsed during his race, multiple times, his coach would give him a concoction each time which would revive him:
            - Egg white
            - Brandy
            - Strychnine
- Adrenaline was the first performance enhancing drug
    - Commonly used for boxing
    - Not ideal as a performance enhancing drug because it has to be injected and is a very short effect
- In 1929 the first amphetamine were engineered
    - Meant to give the benefits of adrenaline over a long period of time and that could be consumed more easily
    - The guy who created it tested on himself
    - When it was first taken it was used as a decongestant
    - Was sold as a cold medication
    - Also noticed it kept him up all night
- The germans used methamphetamine in WWII so the soldiers could stay up all night and drive the machinery
    - Drug companies supplied drugs to the military to help with this
    - Methamphetamine (Pervitin) was used as a cold medication in Germany, and kept people up all night
    - The british (allies) discovered this
- The british did experiments trying to see if they could convert the american amphetamine into methamphetamine that the germans were using
    - Compared methamphetamine, amphetamine and caffeine
    - Pilots that took caffeine developed the shakes
    - Methamphetamine and amphetamine increased the aggression and confiance of the pilots
        - The military loved this
        - It began getting used more for this effect than the sleeplessness
    - Were then industrialized and sold as a pick me up to civilians
- Soldiers came back from war and started using amphetamine in the sports they played
- It then spread out throughout athletes in general
- Was first used in the 1952 by Norwegian speed skating team
    - Wasn't seen as bad
    - They didn't talk about it but that was because they didn't want their competitors to know it could help them
- Knud Enemark jensen Rome Olympic (team cycling race)
    - Still thought it was bad to drink water during sporting events
    - Took amphetamine throughout his race, took it multiple times throughout
    - Collapsed during the race, team mates had to drag him through the race
    - He then fainted and his teammates fell on him and he then died

- Tom Simpson in the Tour de France 1967
    - Was on a mountain that was extremely hot
    - Didn't drink water
        - Race prevented them from drinking water expect in measured amounts
    - He collapsed
    - Went another 100 m and collapsed again and he could not be revived and died on the way to hospital
    - Had high doses of amphetamines
    - Died of heat stroke, his body temperature got so high his brain boiled
- Sympathetic Nervous System (fight or flight)
    - Uses adrenaline as a neurotransmitter
    - Amphetamine can take the place of adrenaline and stimulate the sympathetic nervous system
- Parasympathetic (rest and digest)
- Our bodies have mechanisms in place stop us from being in a "fight or flight" mode for too long
- However amphetamine keeps us in this state for long periods of time
    - Puts us in a position that we just keep going till we die
- In 1967 the olympics restricted drug use and tested for them
    - Sympathomimetic amines
        - Amphetamines
    - Central nervous system stimulants
        - Strychnine
    - Narcotics
        - Heroin
        - Cocaine
    - Antidepressants
    - Tranquilizers
- They were only banned because of the harm it caused to the athletes, not because of the unfair advantage
- Hans-Gunnar Liljenwall Mexico 1968
    - Won bronze and was then stripped fo it
    - Tested positive for alcohol (however alcohol was not on the original list of restricted items)
- Fritz Pregl and Oskar Zoth 1896
    - Injected themselves with bull testical extract
    - Measured an increase in strength using middle fingers
    - The experiment concluded that they were stronger after being injected (we now know this is bogus)
    - And was then known as something that could help athletes
- Charles Edouard Brown-Sequard 1889
    - Married an 18 year old when he was old so injected himself with dog testicle to help him keep up (doctrine of signatures)
- Testicale to trea impotence is a practice that has been around for a really long time
- Fred C Kroth and Lemuel Mc Gee 1926

    - Isolated the chemical testosterone for the first time
    - They were working at the university of chicago
        - Chicago was the slaughter capital of the states and they had lots of raw material available
    - Injected a neutered rooster with testosterone
        - When roosters get neutered they change appearance and start to resemble hens
    - Used 40 kg of bull testicales to abtain 20 mg of testosterone
- Semi Synthesis of testosterone 1935
    - Used cholesterol to convert it to testosterone
        - Cholesterol was readily available from the slaughterhouses
    - This allowed them to do more testing and experiments with testosterone because they had more product to work with
- Steroids in science have a certain molecular structure, they do not necessary give you an advantage in sports
- Testosterone was used to rehabilitate holocaust survivors, used it to rebuild the muscle mass
- First athletes to use the drug were race horses
    - There was still a limited supply, so it was expensive
    - Rich people owned race horses, so it was used on them
- First humans to use the drug were weightlifters in the Soviet Union
- Dr John Ziegler went to a weight lifting competition and found out about the drug from a Soviet coach
- He grouped the effects of the drug
    - Anabolic
        - Muscle mass
        - Strength
        - Bone growth
    - Androgenic
        - Body and facial hair
        - Enlarged vocal chords
        - Heavy brow
        - Acne
        - Increased sex drive
        - Testicle shrinkage
        - Clitoral enlargement
- He knew that he just wanted the anabolic effects and worked with drug companies to change the structure of the traditional testosterone to an Anabolic Steroid
- Anabolic Steroids are a “clean” version of testosterone and drug companies started developing it for hospitals
    - Helps maintain muscle in patients who are in “wasting conditions”
- Dr Manfred Hoppner
    - Director of sports medicine east german (communist) swim team
    - Gave their athletes steroids to prove their way of life was better (versus democratic)

    - However they looked/sounded manly and this was noticed
    - Forced the athletes to take steroids before they even hit puberty to make them "swimming machines"
    - This is what lead the olympics to ban steroids, because young women were being forced to take steroids (because it crossed a line of ethics and was harmful to the athletes)
- East Germany then set up the first doping testing lab for the olympics
    - Used this lab to figure out ways to beat the doping tests
- Testing for steroids:
    - GC/MC (gas chromatograph/mass spectrometer)
        - The GC does a job and feeds its results to the MS and then we can tell if they have drugs
        - First need to get a urine/blood sample (olympics tend to collect one of each)
        - Gas chromatograph
            - sorts the molecules and separate all the different kinds
            - Mix it with gas and pass the gas through a long slender tube that has a sticky lining
            - As the mixture passes the tube it will stick to the wall
            - Depending on the stickiness of the molecule it will take longer/shorter for the molecule to pass through the tube
                - Different molecules will have different amounts of stickiness
            - Measure the time a molecule takes to pass through the tube, this determines what kind of drug it is
            - Gas chromatograph will also measure the amounts of things we have in the sample
        - Mass spectrometer
            - Weigh the molecules to confirm what the molecule is
            - It does this by throwing the molecule through a magnetic field, a the distance it travels determines its mass
            - The machine is designed to induce chemical reactions and the molecules fall apart and break into fragments as it flies through the machine
                - No two molecule does this in the same way
                - So the way that this happens is like a fingerprint, no two molecules have the same fingerprint
- Beating the test
    - Epitestosterone:
        - Steroid affect the ratio of testosterone and epitestosterone,
            - Usually the ratio is 1:1, the olympics will allow a ratio of 4:1
        - When they test for testosterone they test for your ratio of these two thing
        - So the east Germans would inject the steroid and then inject the epitestosterone so they pass the drug tests
    - Diuretics:

        - To flush the steroid out so you don't have a very high amount of the drugs in your systems
    - Ass materials to interfere with testing:
        - Soap and alcohol interfere with the pre treatment of urine before it goes into the GC/MS
    - Urine switching
        - Empty your bladder and then put someone else's urine into your bladder using a catheter
- Modern Semi Synthesis of Steroids
    - Diosgenin to progesterone to testosterone
    - Diosgenin in produced in large amounts in the roots o f mexican yams
    - We can tell the difference between steroids produced from plants and from animals due to Carbon isotopes
        - The ratios of C13 and C12 is how we determine this
- Steroids do not build muscle
- When your muscles are worked out it tears and the body repairs theses tears to be stronger than it was before
    - Need to allow a period of time for the damage to repair before you start working out again
- Steroids cause the body to repair the damage faster, which allows athletes to exercise more often and more intensely
    - Shortens the amount of time it takes for you to build muscles
- Anabolic steroids were developed to speed recovery after a serious accident
    - They also speed up training, allow them to train more often in a shorter period of time
- Health Risks of Steroids:
    - Liver damage
    - Heart damage
    - Reproductive effects
    - Long term effects are unknown (designed for short term use)
- Hard to study the effects because
    - Athletes rarely admit to using steroids
    - They also change their doses
    - Could lie about their doses
    - Athletes mix different types
- BALCO made “designer” steroids
    - Steroids the company made in secret
    - The purpose was to avoid detection
        - Engineered a drug that was unknown so it could not be detected by the testing mechanisms
        - They can not identify a drug if they do not have it’s fingerprint on file
    - No testing was done on the drugs before given to athletes
    - Tetrahydrogestrinone (‘The Clear’)
- Steroids are relatively safe drugs when used properly, however athletes tend to abuse them

    - Over use them
    - Mix drugs
    - Use the drugs improperly
    - Use theses “designer” drugs that have not been tested
- Andarine
    - The future of anabolic drugs
    - Not actually a steroid, but has some of the same anabolic processes
    - Was dropped in the phase 2 of trial by the FDA
    - People started making it in their basements and selling it
- Red Blood Cells transport our O_2 from place to place
    - Have to be replaced constantly
    - The body makes 3 million RBC every second
    - RBC production is controlled by erythropoietin (EPO)
        - The amount present in the body control the amount RBC produced
    - The more RBC (O_2) you have in your body the better your endurance
    - Your RBC count can be increased by training at high altitudes
- Blood doping
    - Remove some of your own blood 3 months before the competition
    - Your body will replace the RBC removed
    - And at the time of competition you put the RBC that were removed back into your bloodstream, increasing your O_2 endurance
    - Can also be done with a close relative's RBC
    - Banned in january 1985 due to the mass discovery of diseases that can be transferred through the blood
    - It is also not super safe to store your blood, the cells begin to distort and change shapes
- If you inject someone with EPO it will help them produce their own RBCs
    - Proteins can be made synthetically but
        - Very expensive
        - Limited quantities
        - Produces large amounts of waste and small amounts of protein
    - We could use animal protein instead however
        - Supply is limited
        - Risk o f infection
        - It only kinda works, since its not actually human
    - Cadavers could be used as a source of protein however:
        - Limited supply
        - Expensive
        - Possibility of infection
    - So we produce recombinant protein (using genetic engineering)
        - Use bacteria/yeast to make a factory that will produce the protein you want
        - Very dafe
        - Tak the gene (set of instructions that make the protein)
        - Put it in a plasmid

        - Inject the plasmid into the factory
        - Better than animal
            - It is human
                - No immune reaction
                - Human protein so it works better
            - Source is safe
                - No risk of infection
                - No allergy problems
            - Can be made in large/unlimited quantities
                - Bacteria/Yeast are easy to grow
        - Can be used instead of blood transfusions
        - Was used as a performance enhancing drug before it was even available on the market
            - While it was in clinical trials cyclist were already using it and had heart attacks
            - This is due to them taking too high of a dose, which caused them to produce too many RBC and their blood became too thick
            - Clinical trials are used to determine dose that how ^ happened
        - Banned by the olympics before it was even on the market
            - However they could not test for it at first
            - They can break up our blood and separate RBC form the rest of our cells, however everyone has a different amount of RBC in their systems
            - Now they use antibodies
                - Urine for total EPO
                - Confirm testing using blood tests
                - Compare values to normal human levels
                - Look at hemoglobin levels
                - Reticulocytes
    - Gene doping
        - Inject someone with genes that produce EPO
        - Up into this point it has been unsuccessful

Summary:

- Temptations to abuse is too great
- Desire to win makes drugs dangerous
    - Athletes push the limits
        - Overuse of drugs
        - Mixing drugs
        - Improper use of drugs
        - Designer drugs
- Drugs are banned from sports for safety reasons