GROWTH , DEVELOPMENT AND MATURITY OF SWIMMERS

DIANE ELLIOT

Objectives of the session

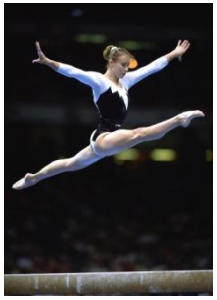
- To introduce coaches to the stages of normal development of children
- To give an understanding of how to measure physical maturity
- To outline the importance of peak height velocity
- To have an understanding of the menstrual cycles and its effects
- To clarify LTAD in swimming

Introduction

- Chronological age is not a good indicator of athletic development
- Ages of 10-16 there is a wide variation of development
  - Physical
  - Cognitive
  - Emotional
- In sports children often grouped together in ages, talent levels, No 1 stroke, distance
  - Training exposure depends on group they are in
- Training should be adjusted to development stage in both males and females

- No evidence that sport and training affects growth or the age at which PHV is reached
- Athletes tend to have lower fat percentage and higher lean muscle mass than population

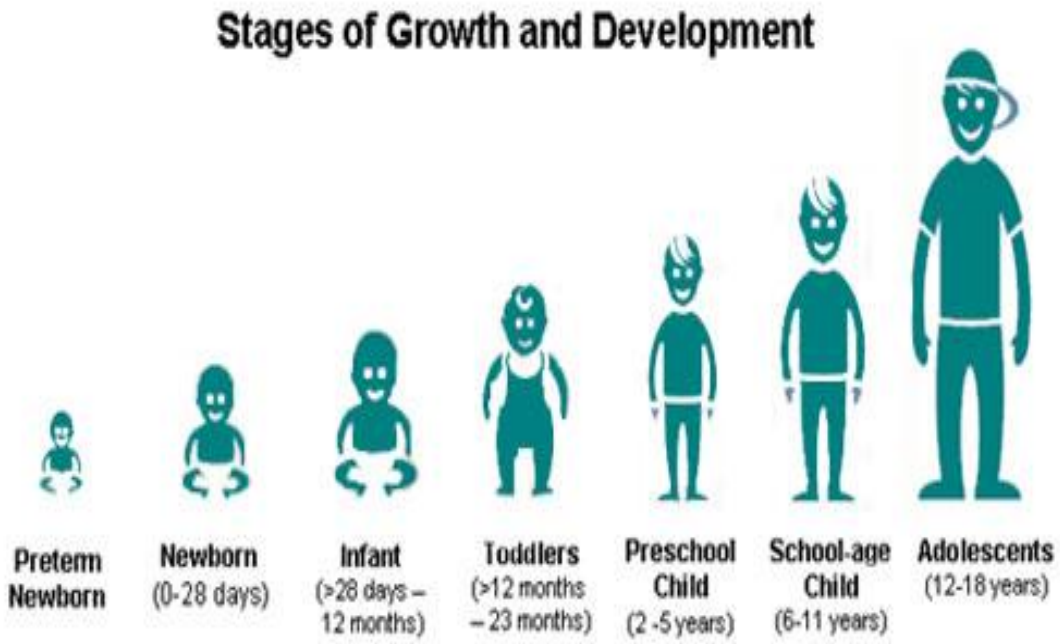
Gymnasts vs. Swimmers



- Late developers
- Shorter height than average
- Parents shorter than average
- Lower body weight than general population and lower body fat

- Early developers
- Taller than average
- Parents taller than average
- Slightly higher body weight than general population but lower body fat

What are the normal stages of growth ?



0-6 years

- Brain grows rapidly and responds to stimulation
- Coordination
- Gross motor skills
- Balance
- Neural connections increasing

6-9 boys/ 6-8 girls

- Steady growth 3-4 inches a year
- Need to develop basic skills
  - Hand foot coordination
  - Balance
  - Agility
  - Rhythmical activities
  - speed
- Develop fine coordination and gross motor skills
- Need clear rules set out
- Difficulty recognising others viewpoint

How do we learn new skills

- Conscious Vs unconscious movement
- Initially we learn a movement through conscious learning
- Eventually it becomes subconscious (habit)

- Habit
  - Do you think about it?

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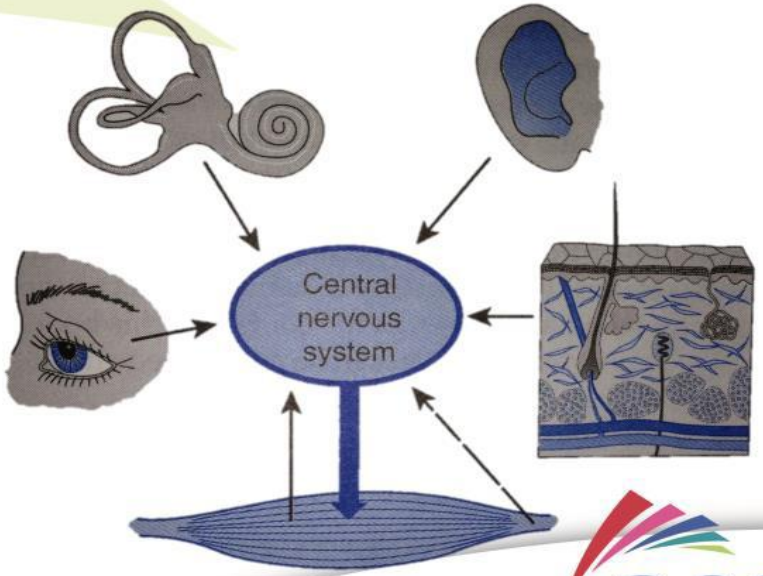
How does the body process information

- Receives signals from several areas
- CNS (brain) processes this information and sends a response to the muscle.
- This is how you create movement



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Developing movement patterns in swimming

- Movement is dependant on both CNS and habits
- CNS—avoiding lane ropes , other swimmers, new technique work, Spotting in open water
- Habits / movement patterns—touching with 2 hands, breathing every 3 strokes, buoy turning etc
- Leaning new skills—need to practice skills perfectly for them to become perfect habits
- Changing technique—needs to be repeated regularly to increase the good technique input into the CNS rather than the bad technique
- Perfect practice makes perfect

9-12 boys, 8-11 girls

- Onset of growth spurt
- Brain nearly adult size
- Puberty can begin for some
- Body image critical at this stage
- Need to work on general skills
- Best time to work on refining skills
- Later developers stay longer in this period and can develop higher level of skills
- Need to consider different activities in this age group due to maturity differences
- Can take on more responsibility and adapt behaviour for different social situations—need to encourage to start taking some responsibility
- Develop coping skills and strategies

Young teens 12-16 males,11-15 females

- Growth spurt
  - Girls 11-14
  - Boys 12-17
- Puberty
  - Girls 11-14
  - Boys 12-15
- Consolidation of skills and basic tactics
- Significant physical development
- Aerobic training a priority at onset of PHV
- Maintain flexibility, skill and strength
- Rapid bone growth so significant importance on flexibility
  - Often muscular pains at this stage
  - May need to reduce some joint stress at period of maximum growth
- Develop logical thinking and consequences of actions
- Can problem solve
- Can action plan
- Cognitive development is uneven and impacted by emotions
- Significant strength gains during this period
  - Females immediately at start of PHV and again at start of first period
  - Males 12-18 months after PHV

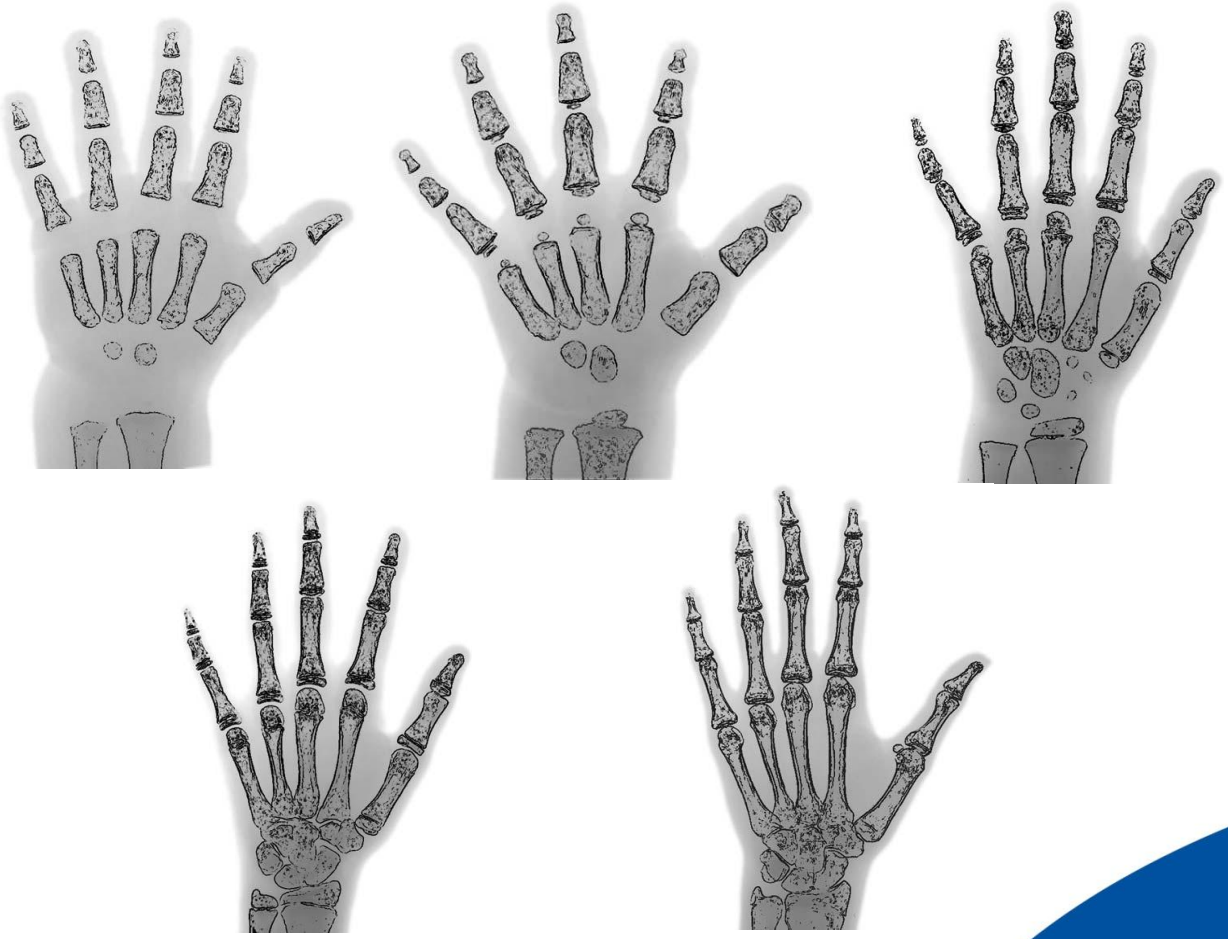
- Growth spurts often cause musculoskeletal issues in athletes
- Eg. Osgood schlatters disease

Teenagers 15-18

- More emotional changes during this stage
- Most girls have completed maturity
- Boys are still developing
- Have complex thought processes
- Express feelings
- Strong sense of right and wrong
- Training tailored to the individual

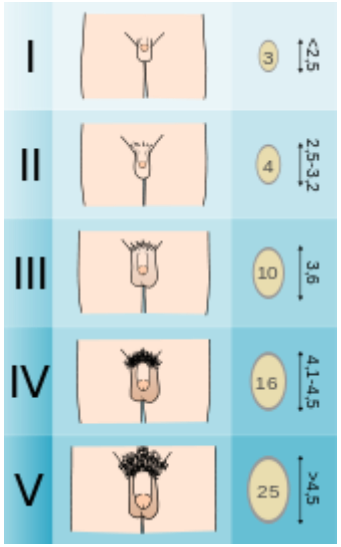
How to measure maturity

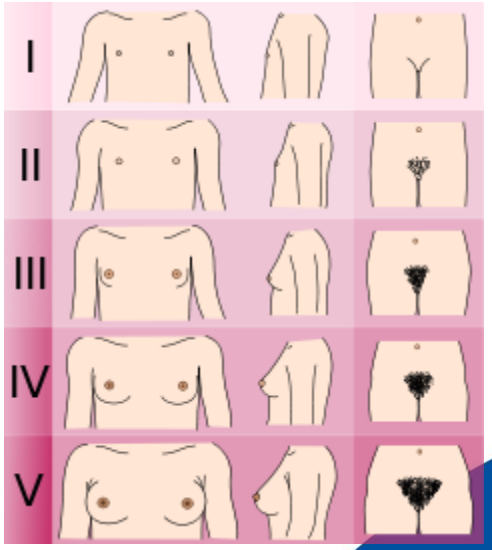
- Gold standard is hand xrays



Tanner Stages

- Scores for genital formation, breast formation and pubic hair
- Widely used in medicine and sports research
- **Not** to be used by coaches due to Child protection issues





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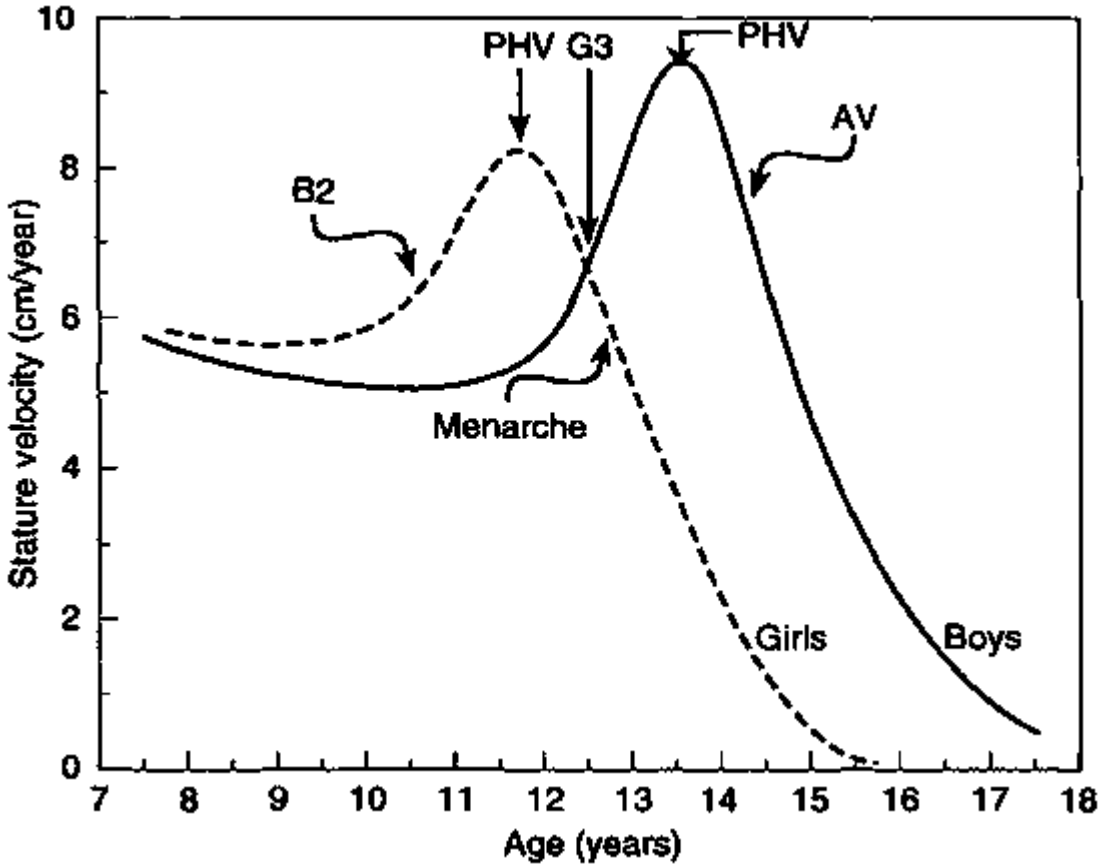
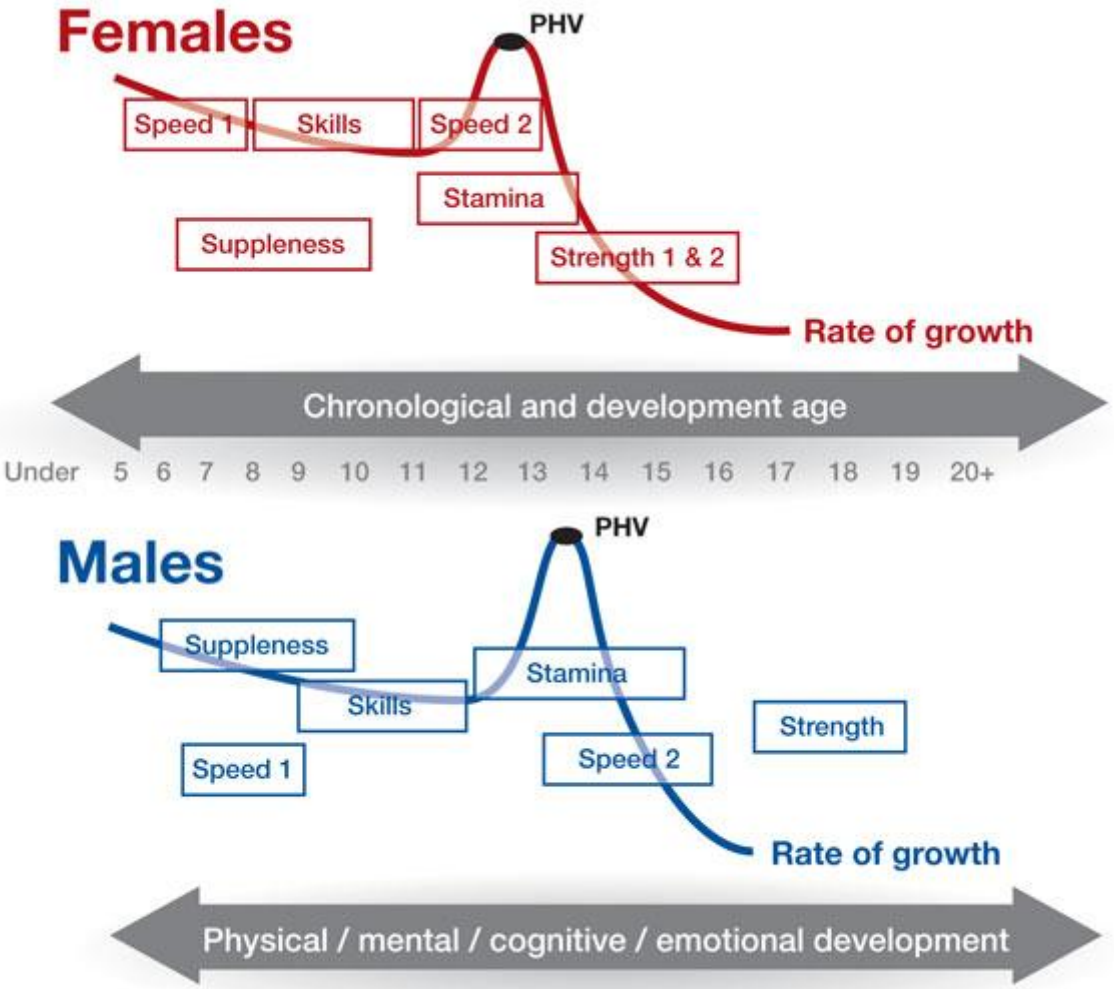
Peak Height Velocity

- Time when a person reaches the maximum growth rate—velocity of growth
- Not maximum height
- Directly linked to development age of athletes
- Practical way of finding a reference point for the design of training programmes
- Influenced by genetics, climate, cultural and social factors
- Girls 10-15 (average 12-13)
- Boys 11-15(average 14)



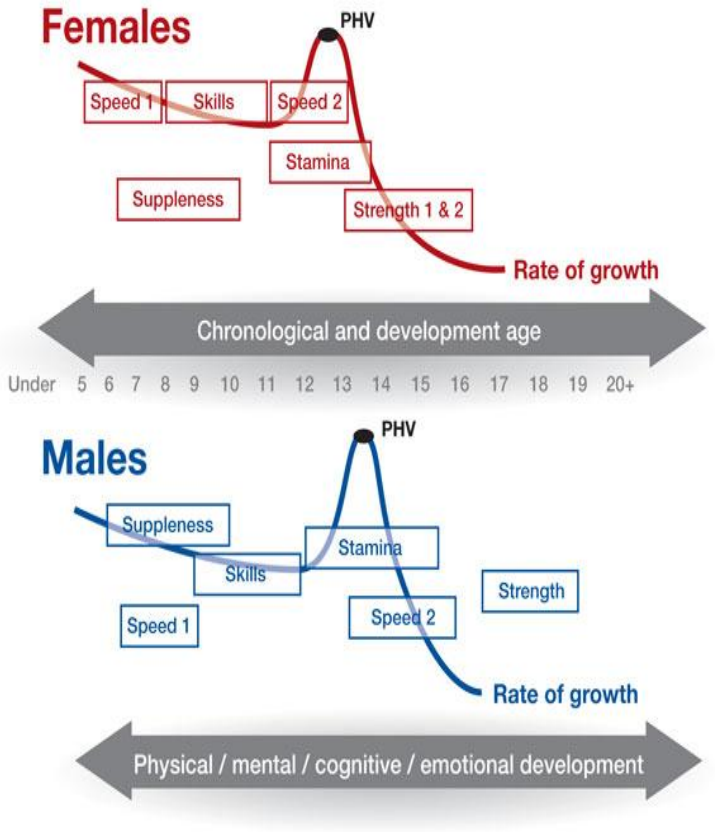
B2-tanner breast 2
G3-genital 3
AV-voice breaking
Menarche-first period

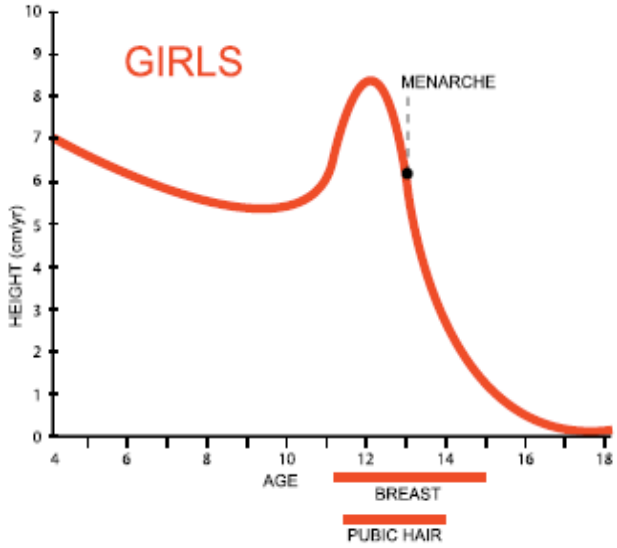
Training in relation to PHV



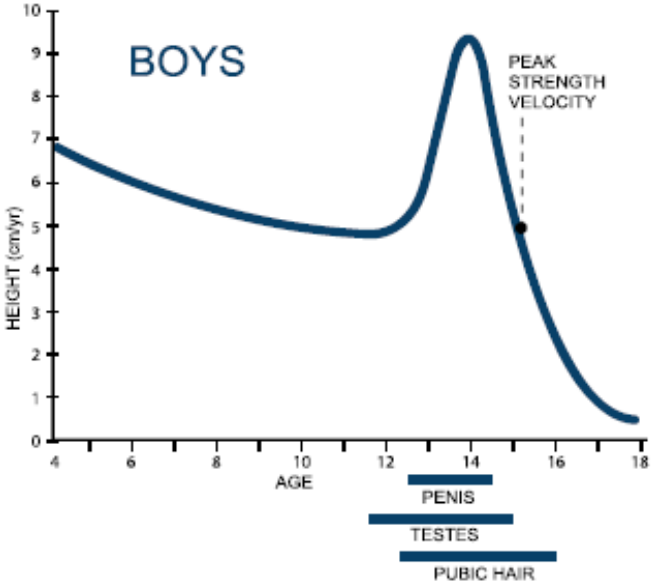
At PHV

- At the onset of PHV aerobic training base should be developed
- Strength window differs f boys and girls
  - Girls have 2 strength windows
  - 1-immediately after PHV
  - 2-at the start of the first period
  - Boys have 1 strength window12-18 months after PHV





PHV in girls occurs at about 12 years of age. Usually the first physical sign of adolescence is breast budding, which occurs slightly after the onset of the growth spurt. Shortly thereafter, pubic hair begins to grow. Menarche, or the onset of menstruation, comes rather late in the growth spurt, occurring after PHV is achieved. The sequence of developmental events may normally occur 2 or even more years earlier or later than average.



PHV in boys is more intense than in girls and on average occurs about 2 years later. Growth of the testes, pubic hair, and penis are related to the maturation process. Peak Strength Velocity (PSV) comes a year or so after PHV. Thus, there is pronounced late gain in strength characteristics of the male athlete. As with girls, the developmental sequence for male athletes may occur 2 or more years earlier or later than average. Early maturing boys may have as much as a 4-year physiological advantage over their late-maturing peers. Eventually, the late maturers will catch up when they experience their growth spurt.

Measurement and Monitoring

- Initially measure standing height from the age of 6
- Do this every 3 months
- Produce a chart of height change (growth) on the vertical axis and age on the horizontal
- As soon as a deceleration in growth is seen followed by an increase in growth then the arm span and sitting height should also be measured—usually around aged 10 for girls and 12 for boys
- Develop charts for each of the 3 measurements being taken
- PHV is the highest point of the growth speed
- After PHV a deceleration of growth occurs
- Monitor for 12-18 months after PHV
- Can last for 1.5 to 5 years
- Remember the windows of opportunity for
  - aerobic work –at start of PHV
  - strength work
  - Boys 12-18 months after PHV
  - Girls-immediately following PHV and again at start of menarche (approx 12 months after PHV)

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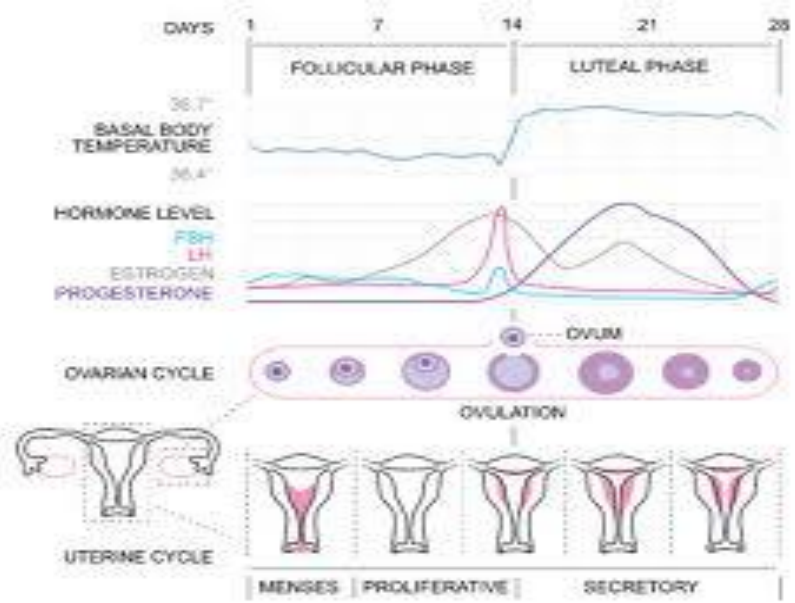
Menstruation

- Thought that menarche is commonly delayed in athletes and they have more irregularities
- No evidence that is it directly linked to sport—indirectly due to nutrition/ energy expenditure
- 37-63% report no detriment to performance during menstruation
- 13-29% reported improvement in performance during menstruation
- Best performance normally immediately after bleeding has stopped
- Worse performance thought to be premenstrally
- Swimmer study—worse times premenstrual and improved during menstruation and after 8th day of cycle
- Increase perceived exertion premenstrually and during early menstruation with intense exercise

Menstruation



- Follicular phase
  - First 5-7 days Menses occurs
  - Ovulation at day 13-14
  - Oestrogen rises after menses at the end of the phase—increases growth hormone which causes fat metabolism

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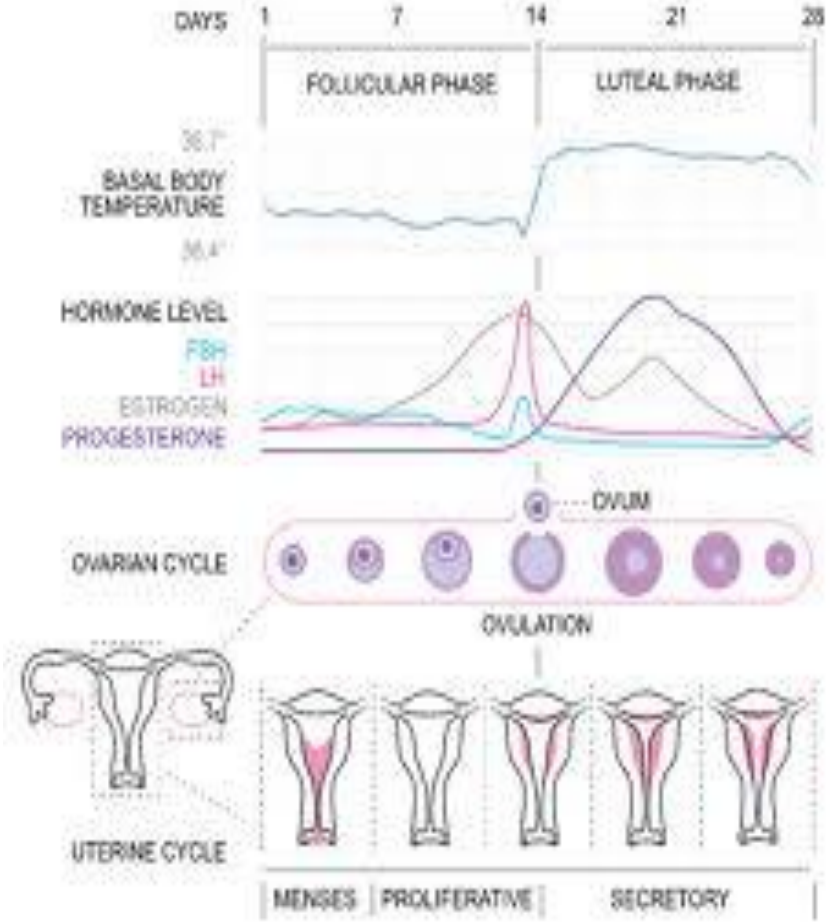

- Luteal Phase
  - Increase core temperature
  - Slight reduction in aerobic capacity—increased heart rate due to increased temp
  - Increased plasma (fluid retention)
  - Increased muscle temperature—slight reduced power
  - Increased metabolic rate (due to temp increase) giving reduced exercise efficiency

Premenstrual symptoms

- End of Luteal phase
- Fluid retention
- Weight gain
- Mood changes
- Potential injury risk

- Documented reduced reaction time, manual dexterity and neuromuscular coordination

Long Term Athlete Development

- Swimming classed as early development sport
- 5 stage pathway—currently under review
- 1. Fundamentals
- 2. swim skills
- Training to train
- Training to compete
- Training to win

- Stage 1
- Fundamentals
- Boys 6-9 girls 5-8
- Short attention span
- Fundamental movement skills
- Multi sport participation
- Games to develop speed , power and endurance
- Body position, gliding, buoyancy
- First critical period of speed development-short bursts less than 5 seconds
- Introduction to simple rules
- ABC’s
  - Agility
  - Balance
  - coordination

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Progressive Development

Fundamentals (6-9yrs)

- **Physical** – Movement Literacy/ ABC's/Short Speed Duration Exercises
- **Technical** – Swim Skills
  Strokes, Starts andTurns
- **Tactical** – Basic Race Introduction
- **Mental** – Positive Reinforcement/Concentration Skills
- **Sessions** – 1-3 Weekly, 30-60 min, Focus High Reps Low Intensity, Skill based

- Stage 2
- Swim Skills
- Girls 9-12, boys 8-11
- Nervous system fully developed
- Rapid improvement in coordination and movement skills
- Sport specific skills and technique
- Starts and turns
- Multi stroke

- Complementary sports—based on energy systems and movement patterns
- Basic ancillary skills
  - Stretching
  - Warm ups
  - Nutrition
  - Hydration
  - Recovery
  - Relaxation

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Progressive Development

Swim Skills (9-12yrs)

- **Physical** – Continued ABC's/Core/Own Body Weight/Flexibility/Warm Up and Cool Down
- **Technical** – Refined Swim Skills/Basic Competition Skills/Lane Etiquette/Pace Clock
- **Tactical** – Aerobic Skill/ Basic Racing Strategy/Knowledge of Pace and Splits
- **Mental** – Introduce Concept of Mental Preparation/Self Confidence/Positive Reinforcement
- **Sessions** – 4-6 Weekly/7hrs+/ Focus High Reps Low Intensity/Maintenance/Skill
- **Training Zones** – A1 A2 AT Sprint

- Stage 3
- Training to train
- Adolescents
- Pre puberty mainly using aerobic system
- After puberty /PHV aerobic capacity increases significantly but proportion of anaerobic energy also increases

- Emphasis on aerobic work after PHV onset
- Development of the heart and lungs critical in this period
- Individual skills and technique work
- High volume low intensity work suggested in LTAD
- Towards end of stage preparation for strength work—technique – posture, alignment, movement patterns
- Stretching key as time of rapid growth

Progressive Development

Training to Train(12-15yrs)

- **Physical** – Balanced Programme/Strength Training Introduction(females earlier)/Effective Core Stability
- **Technica**l – Specific Skills/Profiling/Identify Strength and Weaknesses
- **Tactical** – Observe and Learn Individual Racing Tactics/ Develop Own Tactics
- **Mental** – Goal setting Skills/Imagery/Relaxation Techniques
- **Sessions** – 6-8 Weekly/ 8-16 hrs/ Focus Aerobic Capacity, Speed Race Pace Following PHV
- **Training Zones** – A1 A2 A3 AT Lact T+P (later) Sprint

- Stage 4
- training to Compete
- Girls 15-17, boys 16-18
- Physical conditioning and fitness preparation
- Increasing intensity
- Technical and tactical skills
- Competition specific training

- Significant strength gains post Puberty
- Begin weights if technique is satisfactory

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Progressive Development

Train to Compete(15-18yrs)

- **Physical** – Individualized Event Conditioning/Optimum Preparation(Peak/Taper)
- **Technical** – Advanced Skills Under Racing Pressure
- **Tactical** – Event/Distance Specific Tactical Preparation/ Adaptation to Different Competitive Situations
- **Mental** – Personal Responsibility/Pre Post Comp Routines/ Anxiety Control/Relaxation
- **Sessions** - 8-10 Weekly/16-20 hrs/Focus – Individualised training for event/Racing Tactics In Training Programme
- **Training Zones** – All (Event Driven)

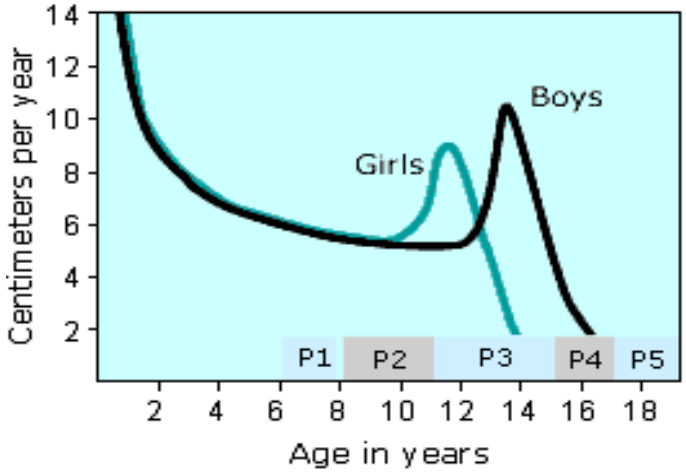
- Stage 5
- training to Win
- Adulthood
- Focus on specific competitions and major events
- Fully established physical, technical, tactical, mental and ancillary skills
- Need high intensity work with recovery breaks

Progressive Development

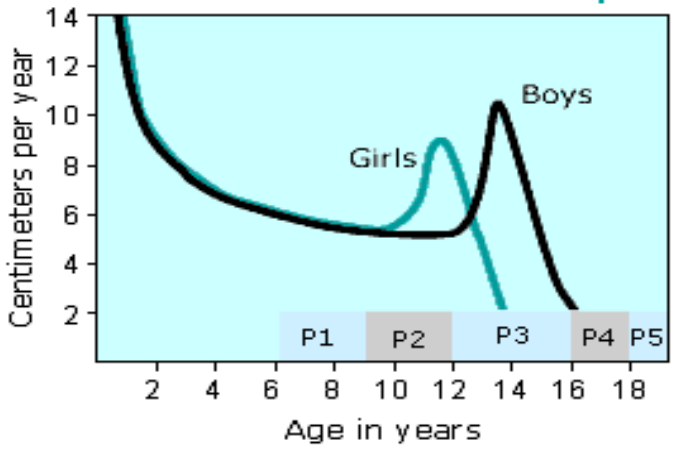
Training to Win (16-18yrs+)

- **Physical** – Maintenance of Current Levels/Strive for Advanced Physical Capacity to Maximise Performance
- **Technical** – Refinement of Specific Race Technique/Skills
- **Tactical** – Develop Adaptation Strategies to Competitive Situations/ Race to Strengths, exploit Opponent Weaknesses
- **Mental** – Coping Strategy for National Team Environment/ Refocus Skills
- **Sessions** – 9 – 10+ Weekly/ 18-22 hrs+/Focus Individual Training Based On Event Speciality
- **Training Zones** – All (Specific)

LTAD Model for Girls



LTAD Model for Boys



Pool/Land Correlation

- **Fundamental Stage (6-9yrs)**

Pool- 4 stroke dev and I/M, Skills 1-3 sessions

Land- ABCs, Speed exercises, movement

1 session weekly

- **Swim Skills Stage (9-12yrs)**

Pool- Racing skills, I/M base, maintenance and skill, 4-6 sessions

Land- Core, circuits, own body weight

2 sessions weekly

Pool/Land Correlation

- **Train to Train (12-15yrs)**

Pool-Aerobic base and I/M ,A1-AT

6-9 sessions

Land- Med Ball/Swiss Ball and previous

3 sessions weekly

- **Train to Compete (15-18yrs)**

Pool- Range of events utilise energy systems for event focus 7-10 sessions

Land- Resistance Training 3-4 weekly

- **Train To Win (16-18yrs+)**

Pool – Specialization 8-12 sessions weekly

Land – Specific work 3-6 sessions weekly

Conclusion

- Key to measure swimmers every 3 months
- Plot growth against age
- Monitor stages of development
- Pre PHV skill work and aerobic work critical
- At the onset of PHV aerobic training base should be developed
- Strength window differs for boys and girls
  - Girls have 2 strength windows
  - 1-immediately after PHV
  - 2-at the start of the first period
  - Boys have 1 strength window12-18 months after PHV
- Remember effects of menstrual cycle on performance especially premenstrual
- Chronological age is not a good indicator of athletic development
- Training and competition should be based on stage of development and not age of swimmer