



Canadian Sport for Life

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Canadian Sport for Life

Through Long-Term Athlete Development

Planning for the
sport excellence
and well-being
of Canadians

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Glossary of Terms

Adaptation refers to a response to a stimulus or a series of stimuli that induces functional and/or morphological changes in the organism. Naturally, the level or degree of adaptation is dependent upon the genetical endowment of an individual. However, the general trends or patterns of adaptation are identified by physiological research, and guidelines are clearly delineated of the various adaptation processes, such as adaptation to muscular endurance or maximum strength.

Adolescence is a difficult period to define in terms of the time of its onset and termination. During this period, most bodily systems become adult both structurally and functionally. Structurally, adolescence begins with an acceleration in the rate of growth in stature, which marks the onset of the adolescent growth spurt. The rate of statural growth reaches a peak, begins a slower or decelerative phase, and finally terminates with the attainment of adult stature. Functionally, adolescence is usually viewed in terms of sexual maturation, which begins with changes in the neuroendocrine system prior to overt physical changes and terminates with the attainment of mature reproductive function.

Ancillary Capacities refer to the knowledge and experience base of an athlete and includes warm-up and cool-down procedures, stretching, nutrition, hydration, rest, recovery, restoration, regeneration, mental preparation, and taper and peak.

The more knowledgeable athletes are about these training and performance factors, the more they can enhance their training and performance levels. When athletes reach their genetic potential and physiologically cannot improve anymore, performance can be improved by using the ancillary capacities to full advantage.

Childhood ordinarily spans the end of infancy — the first birthday — to the start of adolescence and is characterized by relatively steady progress in growth and maturation and rapid progress in neuromuscular or motor development. It is often divided into early childhood, which includes pre-school children aged 1 to 5 years, and late childhood, which includes elementary school-age children, aged 6 through to the onset of adolescence.

Chronological age refers to “the number of years and days elapsed since birth.” Growth, development, and maturation operate in a time framework; that is, the child’s chronological age. Children of the same chronological age can differ by several years in their level of biological maturation. The integrated nature of growth and maturation is achieved by the interaction of genes, hormones, nutrients, and the physical and psychosocial environments in which the individual lives. This complex interaction regulates the child’s growth, neuromuscular maturation, sexual maturation, and general physical metamorphosis during the first 2 decades of life.

Critical periods of development refers to a point in the development of a specific behaviour when experience or training has an optimal effect on development. The same experience, introduced at an earlier or later time, has no effect on or retards later skill acquisition.

Development refers to “the interrelationship between growth and maturation in relation to the passage of time. The concept of development also includes the social, emotional, intellectual, and motor realms of the child.”

The terms “**growth**” and “**maturation**” are often used together and sometimes synonymously. However, each refers to specific biological activities. Growth refers to “observable, step-by-step, measurable changes in body size such as height, weight, and percentage of body fat.” Maturation refers to “qualitative system changes, both structural and functional in nature, in the organism’s progress toward maturity; for example, the change of cartilage to bone in the skeleton.”

Peak height velocity (PHV) is the maximum rate of growth in stature during growth spurt. The age of maximum velocity of growth is called the age at PHV.

Peak strength velocity (PSV) is the maximum rate of increase in strength during growth spurt. The age of maximum increase in strength is called the age at PSV.

Peak weight velocity (PWV) is the maximum rate of increase in weight during growth spurt. The age of maximum increase in weight is called the age at PWV.

Physical literacy refers to the mastering of fundamental motor skills and fundamental sport skills.

Post-natal growth is commonly, although sometimes arbitrarily, divided into 3 or 4 age periods, including infancy, childhood, adolescence, and puberty.

Puberty refers to the point at which an individual is sexually mature and able to reproduce.

Readiness refers to the child’s level of growth, maturity, and development that enables him/her to perform tasks and meet demands through training and competition. Readiness and critical periods of trainability during growth and development of young athletes are also referred to as the correct time for the programming of certain stimuli to achieve optimum adaptation with regard to motor skills, muscular and/or aerobic power.

Skeletal age refers to the maturity of the skeleton determined by the degree of ossification of the bone structure. It is a measure of age that takes into consideration how far given bones have progressed toward maturity, not in size, but with respect to shape and position to one another.

Trainability refers to the genetic endowment of athletes as they respond individually to specific stimuli and adapt to it accordingly. Malina and Bouchard (1991) defined trainability as “the responsiveness of developing individuals at different stages of growth and maturation to the training stimulus.”





Overview

This consultation paper describes a 7-stage Canadian model of Long-Term Athlete Development (LTAD), a training, competition, and recovery program based on developmental age — the maturation level of an individual — rather than chronological age. It is athlete centred, coach driven, and administration, sport science, and sponsor supported. Athletes who progress through LTAD experience training and competition in programs that consider their biological and training ages in creating periodized plans specific to their development needs.

Long-Term Athlete Development

1. is based on the physical, mental, emotional, and cognitive development of children and adolescents. Each stage reflects a different point in athlete development.
2. ensures physical literacy¹ upon which excellence can be built and
 - builds physical literacy in all children, from early childhood to late adolescence by promoting quality daily physical activity in the schools and a common approach to developing physical abilities through community recreation and elite sport programs.
 - recognizes the need to involve all Canadians in LTAD, including athletes with a disability.
3. ensures that optimal training, competition, and recovery programs are provided throughout an athlete's career.
4. provides an optimal competition structure for the various stages of an athlete's development.
5. has an impact on the entire sport continuum, including participants, parents, coaches, schools, clubs, community recreation programs, provincial sport organizations (PSOs), national sport organizations (NSOs), sport science specialists, municipalities, and several government ministries and departments (particularly but not exclusively in the portfolios of health and education) at the provincial/territorial and federal levels.
6. integrates elite sport, community sport and recreation, scholastic sport, and physical education in schools.
7. is 'Made in Canada', recognizing international best practices, research, and normative data.
8. supports the four goals of the Canadian Sport Policy — Enhanced Participation, Enhanced Excellence, Enhanced Capacity, and Enhanced Interaction — and reflects a commitment to contribute to the achievement of these goals.
9. promotes a healthy, physically literate nation whose citizens participate in lifelong physical activity.

¹Physical literacy refers to competency in fundamental motor skills and fundamental sport skills.

Active Start

Males and
Females 0-6



FUNDamentals

Males 6-9
Females 6-8



Learning to Train

Males 9-12
Females 8-11



Training to Train

Males 12-16
Females 11-15



Training to Compete

Males 16-23 +/-
Females 15-21 +/-



Training to Win

Males 19 +/-
Females 18 +/-



Active for Life

Enter At
Any Age



An Outline of LTAD

The first 4 stages, with their respective approximate age ranges, are generally appropriate for all late-specialization sports. In the Training to Compete and Training to Win stages, age ranges vary from sport to sport.

The 10 key factors influencing LTAD

1. The 10-Year Rule
2. The FUNdamentals
3. Specialization
4. Developmental Age
5. Trainability
6. Physical, Mental, Cognitive, and Emotional Development
7. Periodization
8. Calendar Planning for Competition
9. System Alignment and Integration
10. Continuous Improvement

Figure 1 illustrates the stages of LTAD.

Active Start Stage

Chronological Age

Males and Females 0-6

FUN and part of daily life

Fitness and movement skills development

Focus on learning proper movement skills such as running, jumping, wheeling, twisting, kicking, throwing, and catching

Not sedentary for more than 60 minutes except when sleeping

Some organized physical activity

Exploration of risk and limits in safe environments

Active movement environment combined with well-structured gymnastics and swimming programs

Daily physical activity

FUNDamentals Stage

Chronological Age

Males 6-9 and Females 6-8

Overall movement skills

FUN and participation

General, overall development

Integrated mental, cognitive, and emotional development

ABC's of Athleticism: agility, balance, coordination, and speed

ABC's of Athletics: running, jumping, wheeling, and throwing

Medicine ball, Swiss ball, own body strength exercises

Introduce simple rules of ethics of sport

Screening for talent

No periodization, but well-structured programs

Daily physical activity

Learning to Train Stage

Chronological / Development Age

Males 9-12 and Females 8-11

Overall sport skills development

Major skill learning stage: all basic sport skills should be learned before entering Training to Train

Integrated mental, cognitive, and emotional development

Introduction to mental preparation

Medicine ball, Swiss ball, own body strength exercise

Introduce ancillary capacities

Talent Identification

Single or double periodization

Sport specific training 3 times week; participation in other sports 3 times a week

Training to Train Stage

Chronological / Developmental Age
Males 12-16 and Females 11-15

Sport specific skill development

Major fitness development stage: aerobic and strength. The onset of Peak Height Velocity (PHV) *and* PHV are the reference points

Integrated mental, cognitive, and emotional development

Develop mental preparation

Introduce free weights

Develop ancillary capacities

Frequent musculoskeletal evaluations during PHV

Selection

Single or double periodization

Sport specific training 6-9 times per week including complementary sports

Training to Compete Stage

Chronological / Developmental Age
Males 16-23 +/- and Females 15-21 +/-

Sport, event, position-specific physical conditioning

Sport, event, position-specific technical tactical preparation

Sport, event, position-specific technical and playing skills under competitive conditions

Integrated mental, cognitive, and emotional development

Advanced mental preparation

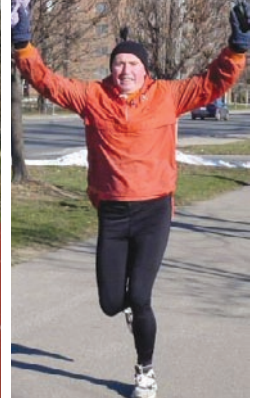
Optimize ancillary capacities

Specialization

Single, double, or triple periodization

Sport specific technical, tactical and fitness training 9-12 times per week





Training to Win Stage

Chronological Age

Males 19 +/- and Females 18 +/-

Ages are sport specific based on international normative data

Maintenance or improvement of physical capacities

Further development of technical, tactical, and playing skills

Modelling all possible aspects of training and performance

Frequent prophylactic breaks

Maximize ancillary capacities

High Performance

Single, double, triple, or multiple periodization

Sport specific technical, tactical, and fitness training 9-15 times per week

Active For Life Stage

Enter At Any Age

Minimum of 60 minutes moderate daily activity or 30 minutes of intense activity for adults

Transfer from one sport to another

Move from highly competitive sport to lifelong competitive sport through age group competition

Move from competitive sport to recreational activities

Move to sport careers or volunteering

There is a better opportunity to be Active for Life if physical literacy is achieved before the Training to Train stage



Introduction

LTAD focuses on the general framework of athlete development with special reference to growth, maturation and development, trainability, and sport system alignment and integration. It incorporates information from a number of sources. It draws on the experiences of various athlete development projects that have been implemented by different sport organizations in British Columbia² since the mid-1990s. It also draws from LTAD work with NSOs including Basketball Canada, the Canadian Curling Association, Speed Skating Canada, the Canadian Alpine Ski Team³, and the Report of the Minister of State's (Sport) Work Group on Sport for Persons with a Disability (2004).

The approach was also influenced by an analysis of the empirically tested athlete development models from the former East Bloc countries, with all the positive and negative aspects of those models. In addition, sport science has provided insight and information regarding the role of growth, development, and maturation in athletic development. These sciences include pediatric exercise science, exercise physiology, sport psychology, psychomotor learning, sport sociology, and nutrition. An analysis of the literature on organizational development has also contributed significantly.

This document is fully based on and supported by the coaching and exercise science literature, but it is written particularly for coaches and technical and administrative sport leaders. Although some of the generalizations may seem to be too vague from a scientific point of view, our extrapolations are drawn because decisions must be made, despite the paucity of scientific studies and data in the area. Thus, the art of coaching plays a significant role in our model.

We recognize that the cognitive, emotional, and psycho-social development of children is an important component of maturation, but because of space constraints, the significance of these components at various stages of maturation are summarized in tables in Appendix 1 on page 54. Additional technical information on LTAD for athletes with a disability is addressed in a separate booklet (to be available in the near future).

The health and well-being of the nation and the medals won at major Games are simple by-products of an effective sport system.

² These BC sport organizations include tennis, water-ski, and curling.

³ Athlete development models were produced for sport organizations in Ireland and Britain, including British Swimming, English Rugby Football Union, England Cricket Board, England Netball, British Canoe Union, and British Judo, are directly quoted from and utilized in the text.



Sport System Alignment and Integration

The need for LTAD arises in part from the declining international performances of Canadian athletes in some sports and the difficulty other sports are having in identifying and developing the next generation of internationally successful athletes. In addition, participation in recreational sport and physical activity has been declining and physical education programs in the schools are being marginalized.

LTAD is a vehicle for change. It differs from other athlete development models because it acknowledges that physical education, school sports, competitive sports, and recreational activities are mutually interdependent.

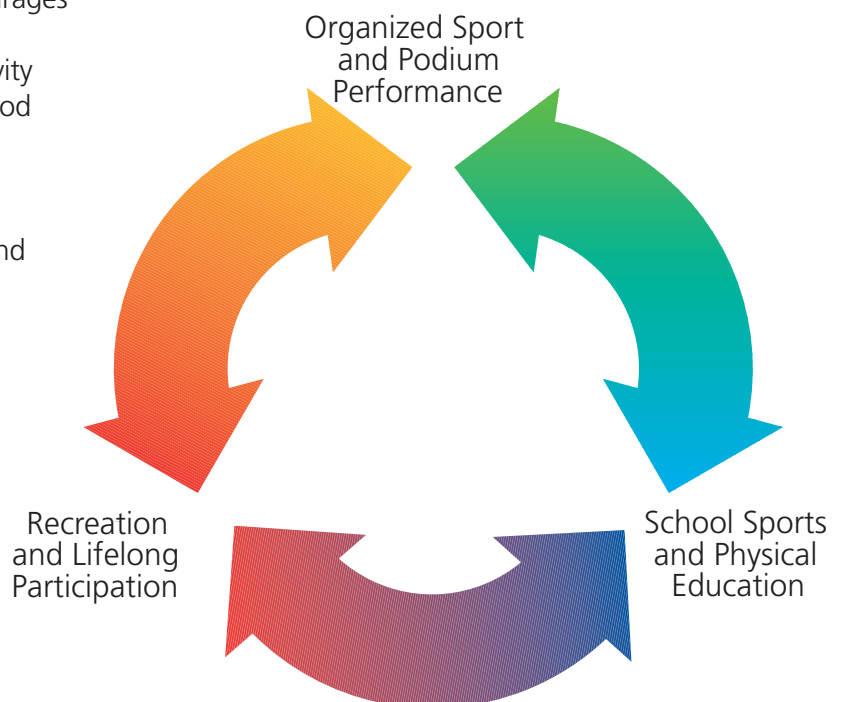
LTAD also positively affects the quality of training and competition by taking into consideration factors such as developmental age and critical periods of optimal trainability. It builds athletic ability beginning with a foundation of fundamental movement skills and introduces fitness and sport skills at the appropriate developmental age. Figure 2 illustrates the recommended support system interrelationship between physical education, recreation, and podium performance.

LTAD stands in sharp contrast to the current Canadian sport system. Traditionally, physical education in the schools, recreational sports, and elite sport have been developed separately. This approach is ineffective and expensive. It fails to ensure that all children, including those who may choose to become elite athletes, are given a solid foundation and knowledge base — physical, technical, tactical, and mental — upon which to build their athletic abilities.

LTAD is an inclusive model that encourages individuals to get involved in lifelong physical activity. It does this by connecting and integrating physical education programs in the school system with elite sport programs and with recreational sport programs in the community. LTAD ensures that all children correctly learn the fundamental movement skills — since all children attend school — and that these skills are introduced during the optimum point in their physical development, which is prior to age 11 for girls and age 12 for boys. Children who are physically educated in the LTAD way will

- feel confident and be encouraged to continue to build on these skills through competitive and recreational sport activity.
- enjoy overall health benefits by developing greater physical literacy, which encourages them to be more physically active throughout their lives. Increased activity reverses the current trends in childhood and adult obesity and cardiovascular disease.
- discover a pathway to competition and excellence at the international level.

Figure 2 Circle of a Physically Active Life



There is another important reason why Canada needs LTAD. In past decades, we have at times attempted to patch the gaps in our sport system by borrowing concepts and systems from countries that have been achieving international athletic success. As an example, during the 1970's and 1980's, Canada tried to adapt elements from the Soviet Union and later from the German Democratic Republic. Prior to and immediately

after the 2000 Olympic and Paralympic Games, many suggested that Canada should try to emulate the Australian sport model. However, for Canadian athletes to achieve international sporting success, Canada must develop a made-in-Canada system that is based on our own culture, traditions, and geography and reflects our social, political, and economic realities. The Canadian LTAD approach attempts to do just that.

LTAD consists of 7 stages.

The first 3 encourage physical literacy and sport for all:

1. Active Start
2. FUNdamentals
3. Learning to Train

The next 3 focus on excellence:

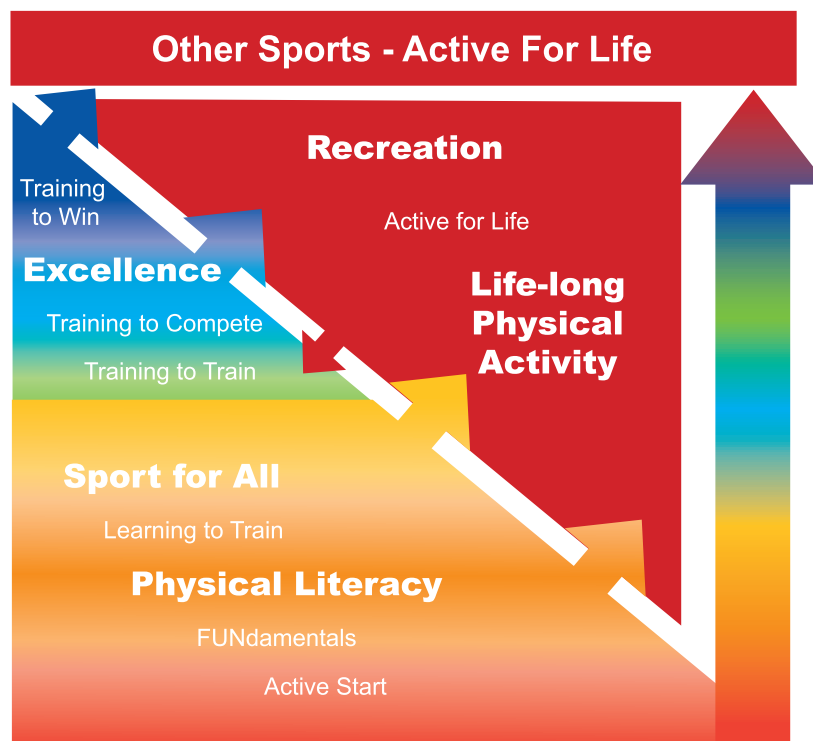
4. Training to Train
5. Training to Compete
6. Training to Win

The final stage encourages life-long physical activity:

7. Active for Life

Figure 3 illustrates an individual's participation in lifelong physical activity, emphasizing the transition from the first 3 LTAD stages to either excellence, life-long participation in the same sport, or remaining active for life in another activity.

Figure 3 Participation In Lifelong Physical Activity (Way et al, 2005)



Shortcomings and Consequences

Before LTAD can be implemented successfully, the many shortcomings and resultant consequences that are impeding the Canadian sport system must be addressed.

Shortcomings

What are the shortcomings?

- developmental athletes over-compete and under-train.
- adult training and competition programs are imposed on developing athletes.
- training methods and competition programs designed for male athletes are imposed on female athletes.
- preparation is geared to the short-term outcome — winning — and not to the process.
- chronological rather than developmental age is used in training and competition planning.
- coaches largely neglect the critical periods of accelerated adaptation to training.
- fundamental movement skills and sport skills are not taught properly.
- the most knowledgeable coaches work at the elite level; volunteers coach at the developmental level where quality, trained coaches are essential.
- parents are not educated about LTAD.
- developmental training needs of athletes with a disability are not well understood.
- in most sports, the competition system interferes with athlete development.
- there is no talent identification (TID) system.
- there is no integration between physical education programs in the schools, recreational community programs, and elite competitive programs.
- sports specialize too early in an attempt to attract and retain participants.

Consequences

What are the results of these shortcomings?

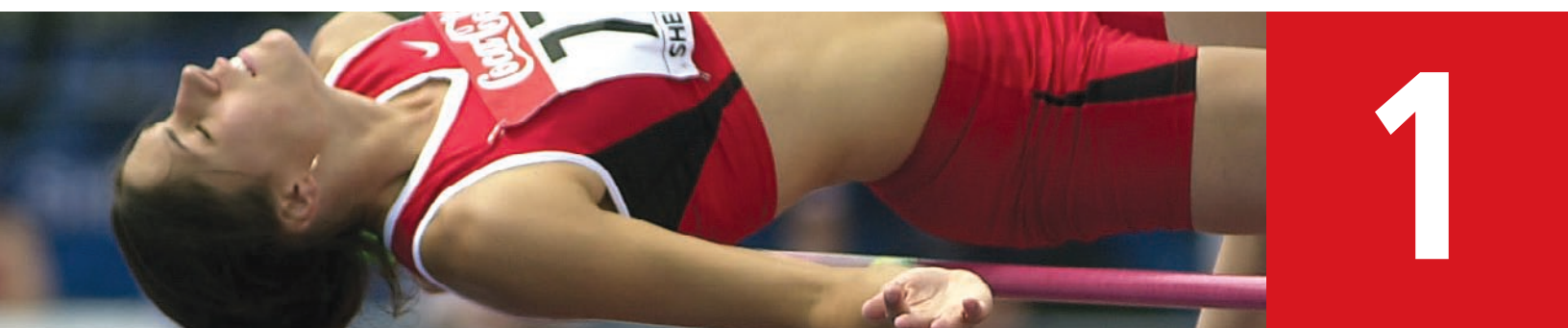
- failure to reach optimal performance levels in international competitions.
- poor movement abilities.
- lack of proper fitness.
- poor skill development.
- bad habits developed from over-competition focused on winning.
- undeveloped and unrefined skills due to under-training.
- female athlete potential not reached due to inappropriate programs.
- children not having fun as they play adult-based programs.
- no systematic development of the next generation of successful international athletes.
- athletes pulled in different directions by school, club, and provincial teams because of the structure of competition programs.
- remedial programs, implemented by provincial and national team coaches, to counteract the shortcomings of athlete preparation.
- fluctuating national performance due to lack of TID and a developmental pathway.
- athletes failing to reach their genetic potential and optimal performance level.

To date, implementation of LTAD in Canada, Ireland, and the United Kingdom indicates that the framework provided by LTAD aids in addressing these shortcomings and enhancing sport system alignment and integration.



The 10 Key Factors Influencing LTAD

The following factors are the research, principles, and tools upon which LTAD is built.



The 10-Year Rule

Scientific research has concluded that it takes a minimum of 10 years and 10,000 hours of training for a talented athlete to reach elite levels. For athlete and coach, this translates into slightly more than 3 hours of training or competition daily for 10 years.

This factor is supported by *The Path to Excellence*, which provides a comprehensive view of the development of U.S. Olympians who competed between 1984 and 1998. The results reveal that

- U.S. Olympians begin their sport participation at the average age of 12.0 for males and 11.5 for females.
- most Olympians reported a 12- to 13-year period of talent development from their sport introduction to making an Olympic team.
- olympic medallists were younger — 1.3 to 3.6 years — during the first 5 stages of development than non-medallists, suggesting that medallists were receiving motor skill development and training at an earlier age. However, caution must be taken not to fall into the trap of early specialization in late specialization sports.

2



The FUNdamentals

FUNdamental movements and skills should be introduced through fun and games. FUNdamental sports skills should follow and include basic overall sports skills.

- FUNdamental movements skills and FUNdamental sports skills = physical literacy.
- Physical literacy refers to competency in movement and sports skills.
- Physical literacy should be developed before the onset of the adolescent growth spurt.



Agility



Balance



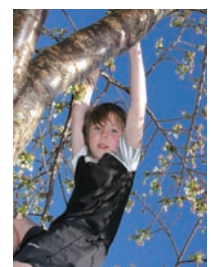
Co-ordination



Speed



Jumping



Climbing



Walking



Skating



Hopping



Swimming



Skipping



Balance



Throwing



Dribbling



Kicking



Throwing



Hitting



Catching

Table 1 lists the wide variety of fundamental movements and skills that underpin physical literacy. They include 4 different environments: earth, water, air, and ice.

Travelling Skills	Object Control Skills	Balance Movements
<ul style="list-style-type: none"> • Boosting • Climbing • Eggbeater • Galloping • Gliding • Hopping • Ice Picking • Jumping • Leaping • Poling • Running • Sculling • Skating • Skipping • Sliding • Swimming • Swinging • Wheeling 	<p>Sending:</p> <ul style="list-style-type: none"> • Kicking • Punting • Rolling (ball) • Strike (ball, puck, ring) • Throwing <p>Receiving:</p> <ul style="list-style-type: none"> • Catching • Stopping • Trapping <p>Travelling with:</p> <ul style="list-style-type: none"> • Dribbling (feet) • Dribbling (hands) • Dribbling (stick) <p>Receiving and Sending:</p> <ul style="list-style-type: none"> • Striking (bat) • Striking (stick) • Volleying 	<ul style="list-style-type: none"> • Balancing/Centering • Body Rolling • Dodging • Eggbeater • Floating • Landing • Ready position • Sinking/Falling • Spinning • Stopping • Stretching/Curling • Swinging • Twisting/Turning <p style="text-align: right; font-size: small;">Jess 1999, adapted Balyi and Way 2004</p>

The basic movement skills of 3 activities provide the base for all other sports

- Athletics: run, wheel, jump or throw.
- Gymnastics: ABC's of athleticism — agility, balance, coordination, and speed.
- Swimming: for water safety reasons, for balance in a buoyant environment, and as the foundation for all water-based sports.

Without the basic movement skills, a child will have difficulty participating in any sport. For example, to enjoy baseball, basketball, cricket, football, netball, handball, rugby, and softball, the simple skill of catching must be mastered.

It is critically important that children with a disability have the opportunity to develop their fundamental movement and sport skills. Failure to do so severely limits their lifelong opportunities for recreational and athletic success. Despite this great need, children with a disability face difficulty gaining the fundamentals because

- overly protective parents, teachers, and coaches shield them from the bumps and bruises of childhood play.
- adapted physical education is not well developed in all school systems.
- some coaches do not welcome children with a disability to their activities because of a lack of knowledge about how to integrate them.
- it takes creativity to integrate a child with a disability into group activities where fundamental skills are practiced and physical literacy developed.

3



Specialization

Sports can be classified as either early or late specialization. Early specialization sports include artistic and acrobatic sports such as gymnastics, diving, and figure skating. These differ from late specialization sports in that very complex skills are learned before maturation since they cannot be fully mastered if taught after maturation.

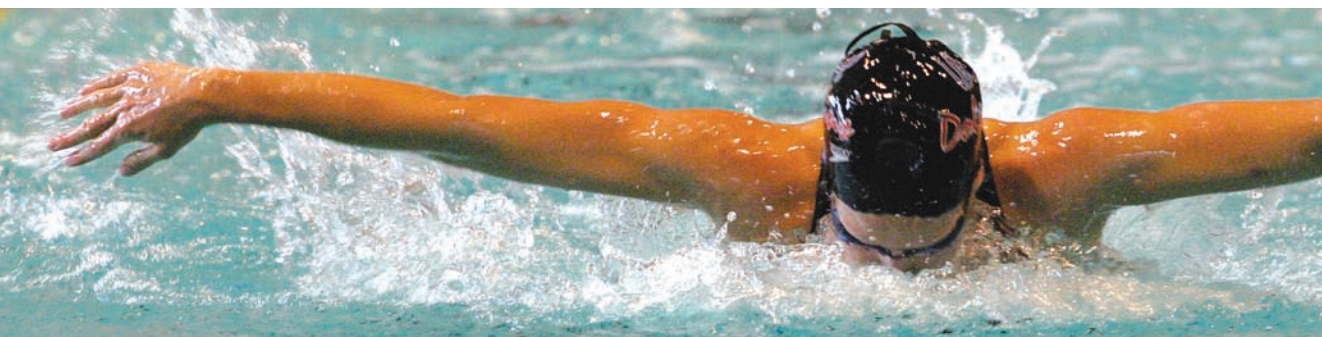
Most other sports are late specialization sports. However, all sports should be individually analyzed using international and national normative data to decide whether they are early or late specialization. If physical literacy is acquired before maturation, athletes can select a late specialization sport when they are between the ages of 12 and 15 and have the potential to rise to international stardom in that sport.

Specializing before the age of 10 in late specialization sports contributes to

- one-sided, sport-specific preparation.
- lack of ABC's, the basic movement and sports skills.
- overuse injuries.
- early burnout.
- early retirement from training and competition.

Disability sports are late specialization and it is critically important that children with a congenital disability or early acquired disability be exposed to the full range of fundamentals before specializing in the sport of their choice.

Early involvement in the FUNdamentals stage is essential in late specialization sports. Many sports resort to remedial programs to try to correct shortcomings.



Developmental Age

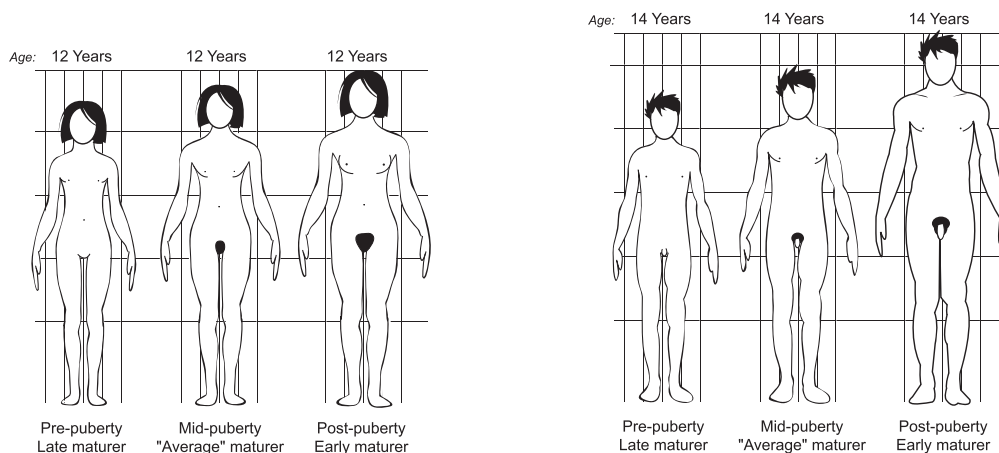
The terms “growth” and “maturation” are often used together and sometimes synonymously. However, each refers to specific biological activities. **Growth** refers to observable step-by-step changes in quantity and measurable changes in body size such as height, weight, and fat percentage. **Maturation** refers to qualitative system changes, both structural and functional, in the body’s progress toward maturity such as the change of cartilage to bone in the skeleton.

Development refers to “the interrelationship between growth and maturation in relation to the passage of time. The concept of development also includes the social, emotional, intellectual, and motor realms of the child.”

Chronological age refers to the number of years and days elapsed since birth. Children of the same chronological age can differ by several years in their level of biological maturation.

Developmental age refers to the degree of physical, mental, cognitive, and emotional maturity. Physical developmental age can be determined by skeletal maturity or bone age after which mental, cognitive, and emotional maturity is incorporated.

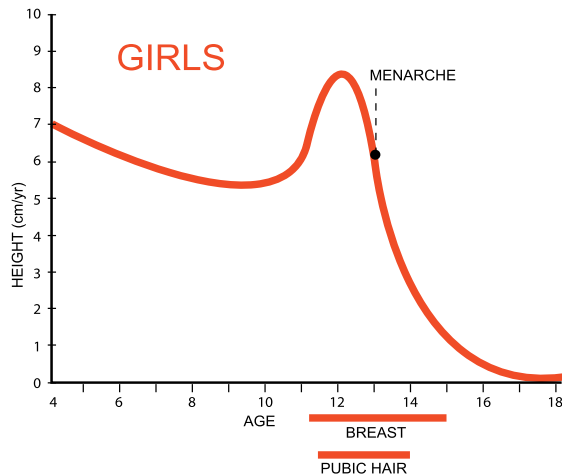
Figure 4 Maturation in Girls and Boys (Adapted from “Growing Up” by J.M. Tanner Scientific American 1973)



LTAD requires the identification of early, average, and late maturers in order to help to design appropriate training and competition programs in relation to optimal trainability and readiness. The beginning of the growth spurt and the peak of the growth spurt are very significant in LTAD applications to training and competition design.

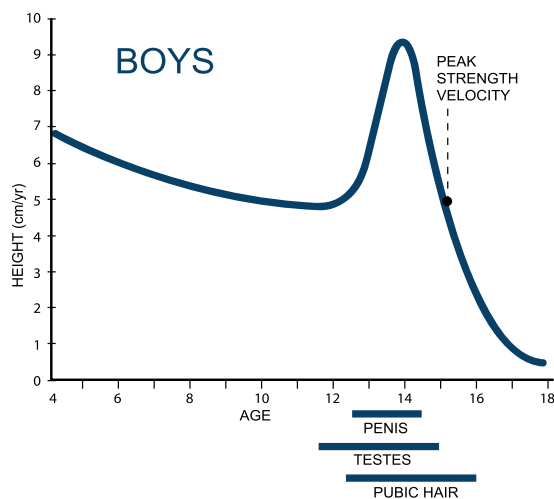
Specific disabilities may dramatically change the timing and sequence of childhood and adolescent development.

Figure 5 Maturity Events in Girls (Modified after Ross et al. 1977)



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.

Figure 6 Maturity Events in Boys (Modified after Ross et al. 1977)



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.

Currently, most athletic training and competition programs are based on chronological age. However, athletes of the same age between ages 10 and 16 can be 4 to 5 years apart developmentally. Thus, chronological age is a poor guide to segregate adolescents for competitions.

Training age refers to the age where athletes begin planned, regular, serious involvement in training. The tempo of a child's growth has significant implications for athletic training because children who mature at an early age have a major advantage during the Training to Train stage compared to average or late maturers. However, after all athletes have gone through their growth spurt, it is often later maturers who have greater potential to become top athletes provided they experience quality coaching throughout that period.



Trainability

The terms “adaptation” and “trainability” are often used interchangeably in coaching. However, the difference between them is significant.

Adaptation refers to changes in the body as a result of a stimulus that induces functional and/or morphological changes in the organism. The degree of adaptation is dependent on the genetic endowment of an individual. However, the general trends or patterns of adaptation are identified by physiological research, and guidelines are clearly delineated of the various adaptation processes, such as adaptation to muscular endurance or maximum strength.

Trainability refers to the faster adaptation to stimuli and the genetic endowment of athletes as they respond individually to specific stimuli and adapt to it accordingly. Trainability has been defined as the responsiveness of developing individuals to the training stimulus at different stages of growth and maturation.

A critical period of development refers to the point in the development of a specific capacity when training has an optimal effect. Other factors are readiness and critical periods of trainability during growth and development of young athletes, where the stimulus must be timed to achieve optimum adaptation with regard to motor skills, muscular, and/or aerobic power.

Figure 7 Variation in Trainability (Adapted from work by Bouchard et.al., 1997)

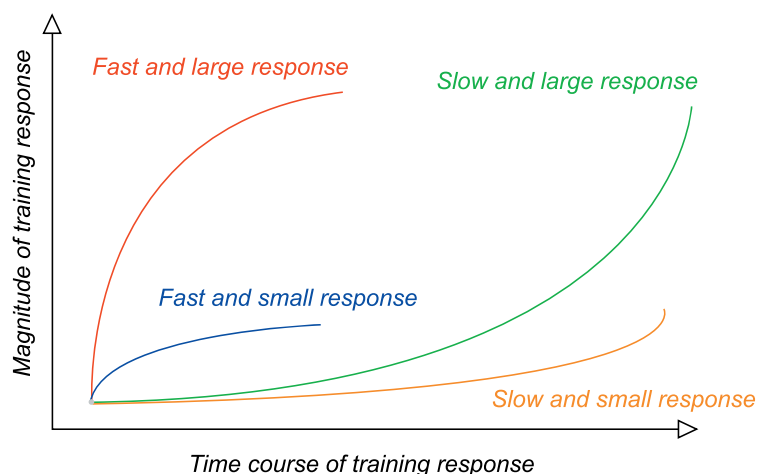


Figure 7 illustrates the evidence to date that supports the fact that there is a high degree of variation in the trainability of humans (athletes), both from the standpoint of the magnitude of change and the time course of response to a given stimulus. This probably reflects the ‘elasticity’ of response to various stimuli and human diversity (as largely dictated by the underlying genetic matrix and supported by the environment in which an individual is immersed) (Norris & Smith, 2002).

The 5 Basic S's of Training and Performance are Stamina (Endurance), Strength, Speed, Skill, and Suppleness (Flexibility). (Dick, 1985)



Stamina (Endurance)

The optimal window of trainability occurs at the onset of PHV. Aerobic capacity training is recommended before athletes reach PHV. Aerobic power should be introduced progressively after growth rate decelerates.



Strength

The optimal window of trainability for girls is immediately after PHV or at the onset of the menarche, while for boys it is 12 to 18 months after PHV.



Speed

For boys, the first speed training window occurs between the ages of 7 and 9 years and the second window occurs between the ages of 13 and 16. For girls, the first speed training window occurs between the ages of 6 and 8 years and the second window occurs between the ages of 11 and 13 years.



Skill

The window for optimal skill training for boys takes place between the ages of 9 and 12 and between the ages of 8 and 11 for girls.



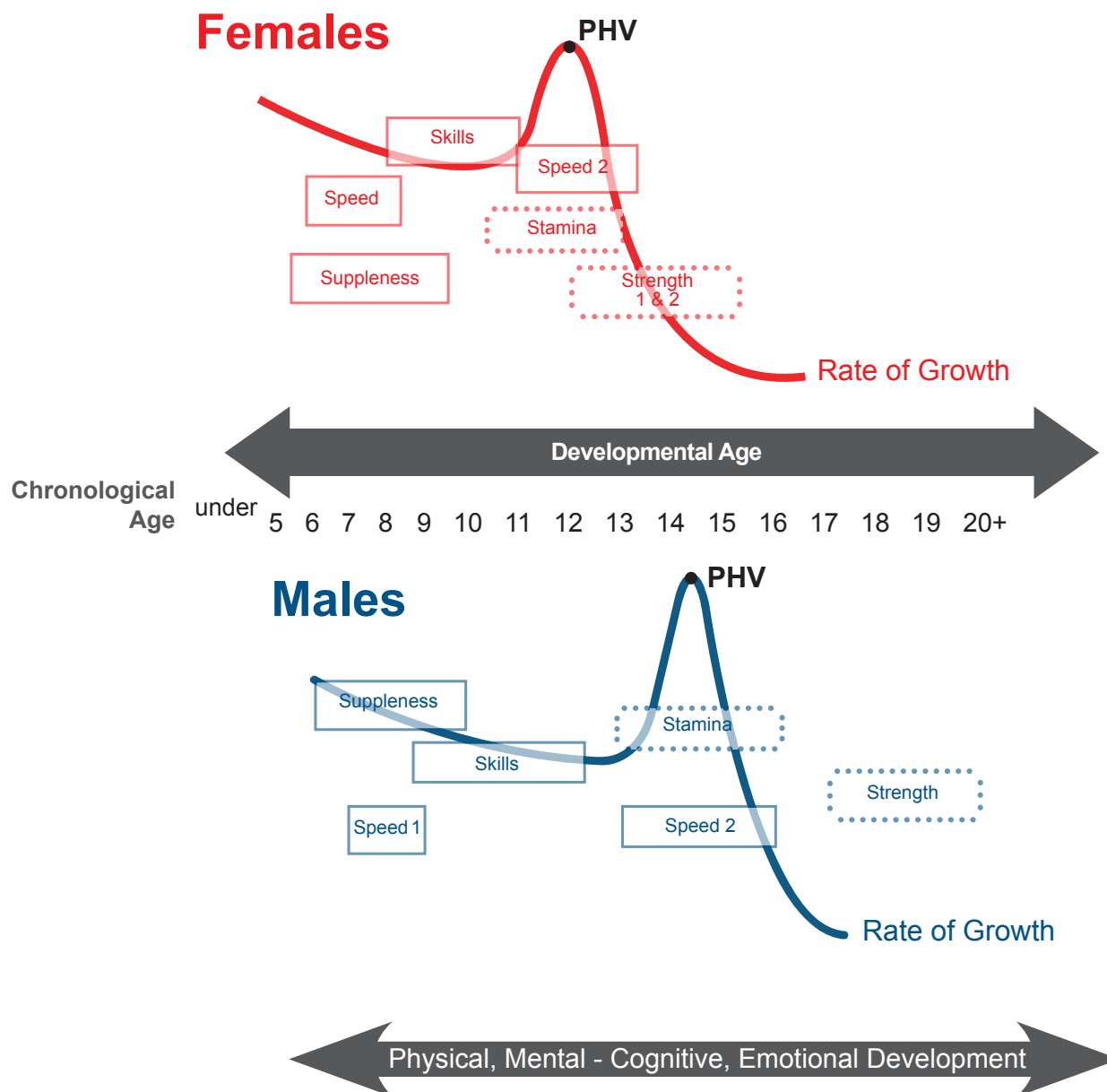
Suppleness (Flexibility)

The optimal window of trainability for suppleness for both genders occurs between the ages of 6 and 10. Special attention should be paid to flexibility during PHV.

Figure 8 illustrates the Windows of Optimal Trainability for Females and Males. Two windows — stamina and strength — are based on the moving scales of the onset of the growth spurt and PHV. The other 3 windows — speed, skill, and suppleness — are based on chronological age.

The trainability of the different systems for children and youth with a disability is not well understood. Applying this information to specific athletes with a disability is a good example of coaching being an art as well as a science.

Figure 8 Pacific Sport - Optimal Windows of Trainability (Balyi and Way, 2005)



All Systems Are Always Trainable!

6



Physical, Mental, Cognitive, and Emotional Development

Training and competitive and recovery programs should consider the mental, cognitive, and emotional development of each athlete.

Beyond the physical, technical, and tactical development — including decision-making skills — the mental, cognitive, and emotional development should be enhanced.

For a complete overview of mental, cognitive, and emotional development characteristics and their implications for the coach, refer to Appendix 1 on page 54.

A major objective of LTAD is a holistic approach to athlete development. This includes emphasis on ethics, fair play, and character building throughout the various stages, an objective that reflects Canadian values. Programming should be designed considering athletes' cognitive ability to address these concepts.

7



Periodization

Simply put, periodization is time management. As a planning technique, it provides the framework for arranging the complex array of training processes into a logical and scientifically-based schedule to bring about optimal improvements in performance.

Periodization sequences the training components into weeks, days, and sessions. Periodization is situation specific depending upon priorities and the time available to bring about the required training and competition improvement. In the LTAD context, periodization connects the stage the athlete is in to the requirements of that stage.

Periodization organizes and manipulates the aspects of modality, volume, intensity, and frequency of training through long-term (multi-year) and short-term (annual) training, competition, and recovery programs to achieve peak performances when required.

Periodization, far from being a single fixed process or methodology, is in fact a highly flexible tool. When used appropriately in conjunction with sound methodology and ongoing monitoring and evaluation, it is an essential component in optimal sports programming and athlete development at all levels.

LTAD addresses this requirement by developing periodization models for all stages, taking into consideration the growth, maturation, and trainability principles that are unique to the primary development stages — the first 2 decades of life — yet seamlessly integrate with the subsequent stages of athletic performance and life.

LTAD is typically a 10- to 12-year procedure that optimizes physical, technical, tactical — including decision making — and mental preparation, as well as the supporting ancillary capacities. Within LTAD is quadrennial planning, which refers to the 4-year Olympic and Paralympic cycle for elite athletes, and the annual plan, which is based upon identified periods of athletic preparation, competition, and the transition into the next calendar plan.

Current examples of periodization models identified in the sport performance literature are designed for the sub-elite and elite senior/mature performers. There is very little information on periodization for children or adolescents or for athletes with disability.

Single, double, triple, and multiple periodization formats follow the same principles with frequently introduced prophylactic breaks; that is, programmed and prioritized recovery and regeneration elements.

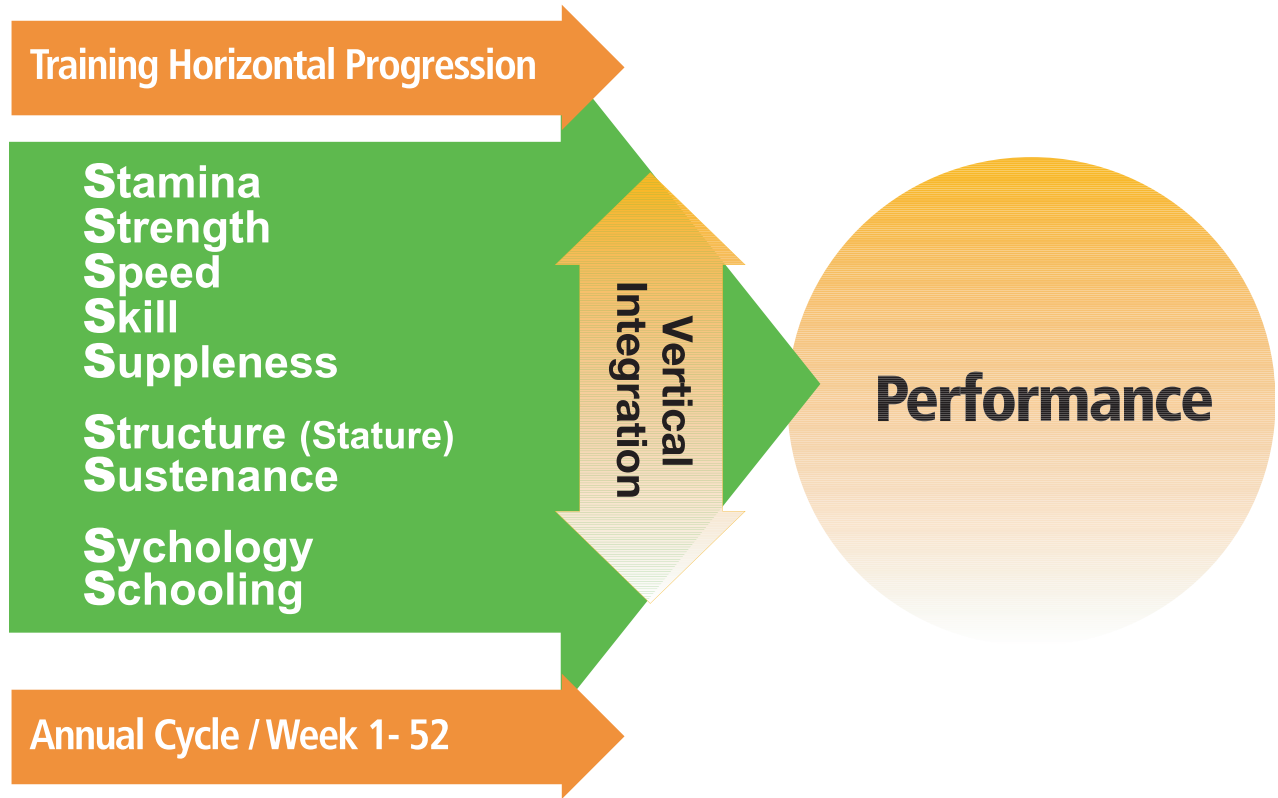
The terminology that describes the smaller subsets of time — organized blocks of training or competition — is macro, meso, and micro cycles. Macro cycles are the largest blocks within a phase of training and are usually 8 to 16 weeks in length. Meso cycles are smaller blocks of time, usually about a month. The smallest training block is often organized as a micro cycle and by convention is usually 7 days. The introduction of a recovery micro cycle determines the length of a meso cycle after 1 (1:1), 2 (2:1), 3 (3:1) or 4 (4:1) loading micro cycles.

Table 2 illustrates the phases of an annual plan for a single or double periodization.

Five Phases of A Single Periodized Annual Plan	Eight Phases of A Double Periodized Annual Plan
General Preparation Phase (GPP) Specific Preparation Phase (SPP) Pre-Competition Phase (PCP) Competition Phase <i>Peak</i> (CP) Transition Phase (TP)	General Preparation Phase (GPP) Specific Preparation Phase (SPP) 1 Pre-Competition Phase (PCP) 1 Competition Phase (CP) 1 <i>Peak One</i> Specific Preparation Phase (SPP) 2 Pre-Competition Phase (PCP) 2 Competition Phase (CP) 2 <i>Peak Two</i> Transition Phase (TP)

Figure 9 illustrates the 'art and science' required by the coach when planning the horizontal and vertical integration of the 9 Expanded S's of training and performance. The horizontal arrows represent the progress of an athlete that is quantifiable and based on scientific guidelines; the vertical integration is based on the interrelationship of each aspect of training and performance, which is often based on the 'art' of coaching.

Figure 9 Horizontal and Vertical Intergration9 Expanded S's - The Art and Science of Coaching
 (Balyi, 2004 and Norris, 2000)



Calendar Planning for Competition

Optimal competition calendar planning at all stages is critical to athlete development. At certain stages, developing the physical capacities take precedence over competition. At later stages, the ability to compete well becomes the focus.

Table 3 outlines general recommendations for the ratio of training to competition and competition specific training. Consider how the quantity and quality of the training and competition program changes as long-term plans progress.

Table 3: Training to Competition Ratios

Stages	Recommended Ratio
Active Start	No specific ratios
FUNdamentals	All activity FUN based
Learning to Train	70% training to 30% competition
Training to Train	60% training to 40% competition
Training to Compete	40% training to 60% actual competition and competition specific training
Training to Win	25% training to 75% actual competition and competition specific training
Active for Life	Based on individual's desire

- Optimal sport specific competition ratios are required for all stages of LTAD.
- Level and length of the competitive season should be aligned with the changing needs of the developmental athlete progressing through LTAD.
- Over-competition and under-training at the Learn to Train and Train to Train stages result in a lack of basic skills and fitness.
- The appropriate level of competition is critical to the technical, tactical, and mental development at all stages.
- Schedules are often 'set' for team sports by leagues and organizations and not by the coach and athlete, making optimal training based on periodization difficult. For individual sports, individual competition schedules can be selected by the coach and athlete based on the athlete's developmental needs.
- The current system of competition is based on tradition. It should be planned to enhance optimal training and performance of the athlete depending upon their LTAD stage.
- Competitions in Canada must be created and scheduled considering strategic planning and with due regard for the optimal performance of an athlete and the tapering and peaking requirements.

- Optimal training to competition ratios for individual sports vary greatly and must be determined on a sport specific basis.
- While international and national calendars are usually well integrated, a systematic competition review needs to be undertaken. This is one of the biggest challenges for team sports and a significant challenge for individual sports in LTAD design and implementation.

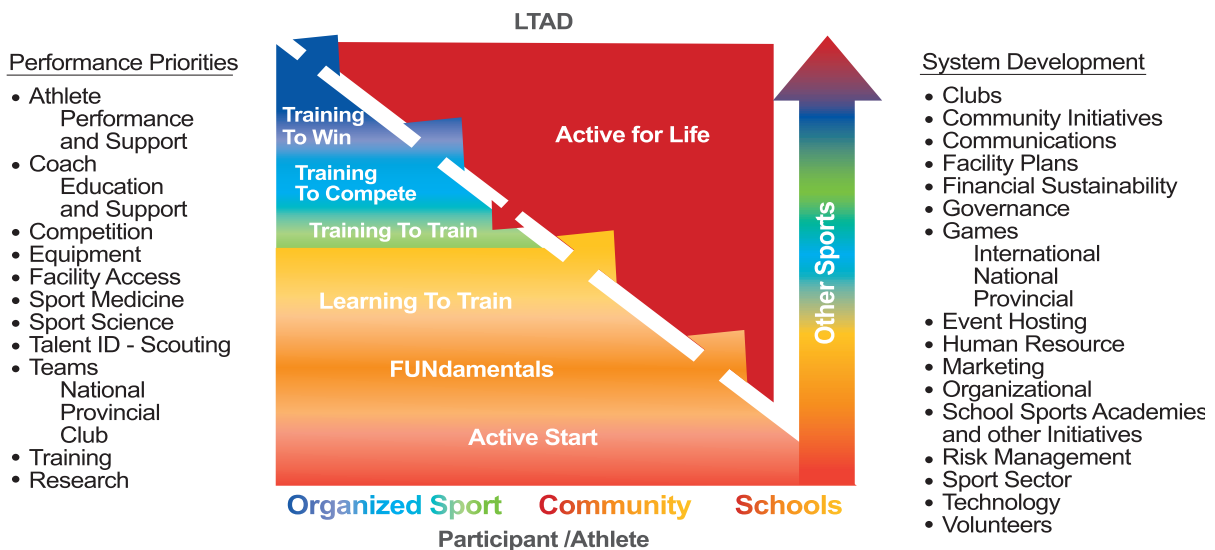
The system of competition makes or breaks athletes!



System Alignment and Integration

Figure 10 illustrates the various performance priorities that LTAD addresses and the system development it effects.

Figure 10 System Alignment and Integration (Way et. al 2005)

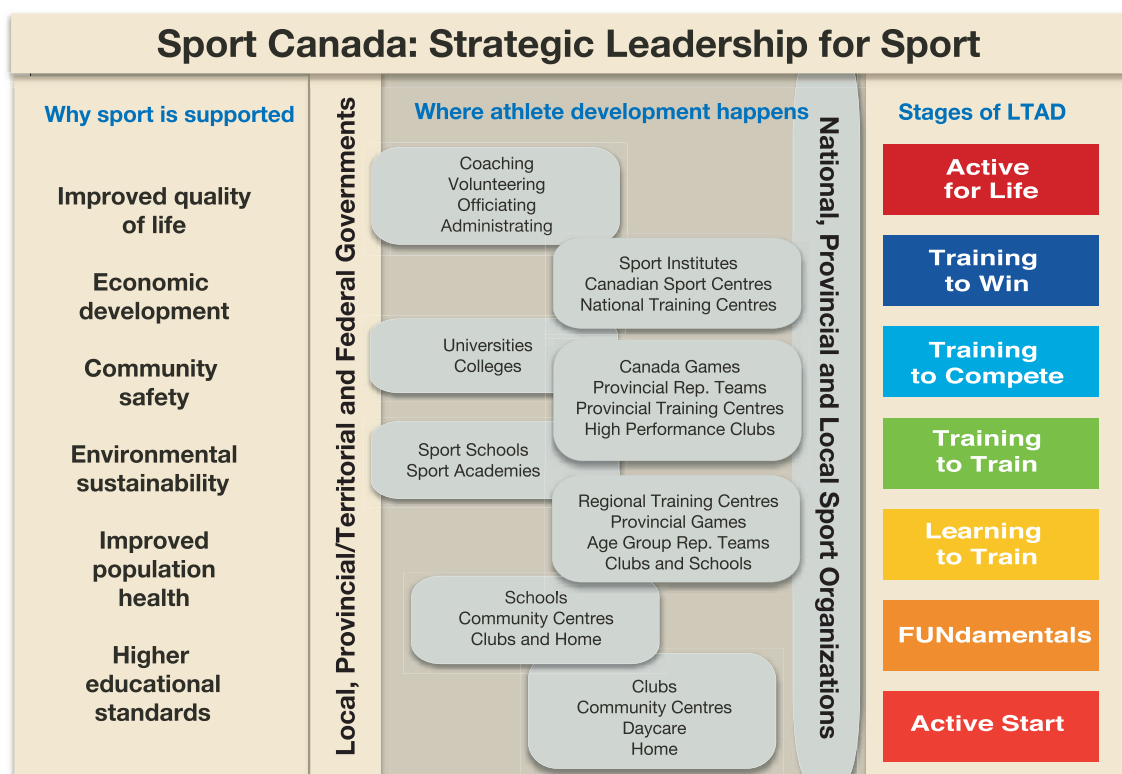


- LTAD is the core business of national, provincial/territorial, and local sport organizations.
- LTAD is a tool for change towards full system alignment and integration.
- A seamless, sport-specific LTAD should be based on national and international normative data, both sport specific and sport science.

- LTAD plans for athletes with a disability need to be developed on a sport-by-sport basis taking into account the specific needs of individuals with a congenital or acquired disability.
- After the LTAD design is completed, a sport-specific system of competition should be established that matches the competitive needs of developmental athletes during Active Start, FUNdamentals, Learning to Train, and Training to Train stages.
- The content of training, competition, and recovery during the FUNdamentals, Learning to Train, and Training to Train stages are defined, taking into consideration the developmental levels of the athletes as these relate to the physical, technical, tactical — including decision making — and mental requirements of the sport, rather than being based on chronological age.
- LTAD is an athlete-centered approach designed around the needs of athletes and institutionalized by rationalization of the system by sport governing bodies.
- The process of designing and implementing LTAD programs is athlete centered, coach driven, and administration, sport science, and sponsor supported.
- LTAD has a strong impact on the coaching education curriculum. Developmental readiness will replace ad hoc decision-making about programming preparation.
- Activities of schools, communities, clubs, PSOs, and NSOs should be fully integrated through LTAD.

Figure 11 illustrates the relationship between national and local agencies and programs. To build on the four goals of the Canadian Sport Policy, LTAD must be supported and promoted by all levels of government including Canadian Heritage (Sport Canada) and the provincial/territorial ministries responsible for sport and recreation; provincial/territorial health ministries and Health Canada; provincial/territorial education ministries; other relevant federal and provincial/territorial departments and ministries; and municipal governments.

Figure 11 Strategic Leadership for Sport (Sport England, 2004 - Modified by Higgs & Way 2005)



10



Continuous Improvement

The concept of continuous improvement, which permeates LTAD, is drawn from the respected Japanese industrial philosophy known as Kaizen.

Continuous improvement ensures that

- LTAD responds and reacts to new scientific and sport-specific innovations and observations and is subject to continuous research in all its aspects.
- LTAD, as a continuously evolving vehicle for change, reflects all emerging facets of physical education, sport, and recreation to ensure systematic and logical delivery of programs to all ages.
- LTAD promotes ongoing education and sensitization of federal, provincial/territorial, and municipal governments, the mass media, sport and recreation administrators, coaches, sport scientists, parents, and educators about the interlocking relationship between physical education, school sport, community recreation, life-long physical activity, and high performance sport.





Stages of LTAD

Stages of LTAD

Sports can be classified as early or late specialization. The stages of LTAD are based on this concept.⁴

Early Specialization Model

1. Active Start
2. FUNdamentals / Learning to Train / Training to Train
3. Training to Compete
4. Training to Win
5. Active for Life

Late Specialization Model

1. Active Start
2. FUNdamentals
3. Learning to Train
4. Training to Train
5. Training to Compete
6. Training to Win
7. Active for Life

These models are general in nature and require adjustment on a sport specific basis.

The wording used to denote these stages can be changed to make it more applicable to specific sports. For example, for the sport of speed skating, Learning to Train could become Skateskills. Skiing could change the FUNdamentals Stage to Bumps and Jumps.

Speed Skating Canada has introduced 2 Training to Compete and 2 Training to Win stages to deal with the sport-specific requirements of athlete development (See Appendix 2, page 63). Most sports use the terminology in the chart to describe the stages of LTAD because it clearly describes what is to be done during each.

Since few sports can be categorized as early specialization sports, LTAD focuses on late specialization sports (see Specialization, page 22). Briefly, each early specialization sport should develop a sport-specific model; a general model would lead to serious oversimplifications. The challenge is to combine the FUNdamentals and Learning to Train stages or amalgamate them into a single stage, such as the Training to Train stage. For late specialization sports, specialization prior to age 10 is not recommended since it contributes to early burn-out, drop-out, and retirement from training and competition.

⁴ Currently, over 30 NSOs in England, Scotland, Northern Ireland, Wales, and the Republic of Ireland, have endorsed a six-stage model without Active Start.

Active Start

Age: 0-6



Objectives

Learn fundamental movements and link them together into play.

Physical activity is essential for healthy child development. Among its other benefits, physical activity

- enhances development of brain function, coordination, social skills, gross motor skills, emotions, leadership, and imagination.
- helps children to build confidence and positive self-esteem.
- helps to build strong bones and muscles, improves flexibility, develops good posture and balance, improves fitness, reduces stress, and improves sleep.
- promotes healthy weight.
- helps children learn to move skillfully and enjoy being active.

Physical activity should be fun and a part of the child's daily life, not something required. Active play is the way young children are physically active.

Organized physical activity and active play are particularly important for the healthy development of children with a disability if they are to acquire habits of lifelong activity.

Because this is a period when children rapidly outgrow their mobility aids, communities need to find effective ways — equipment swaps or rentals, for example — to ensure that all children have access to the equipment they need to be active.

Active Start To-Do List

- Provide organized physical activity for at least 30 minutes a day for toddlers and at least 60 minutes a day for preschoolers.
- Provide unstructured physical activity — active play — for at least 60 minutes a day, and up to several hours per day for toddlers and preschoolers. Toddlers and preschoolers should not be sedentary for more than 60 minutes at a time except while sleeping.
- Provide physical activity every day regardless of the weather.
- Starting in infancy, provide infants, toddlers, and preschoolers with opportunities to participate in daily physical activity that promotes fitness and movement skills. Provide parents and care givers with age-appropriate information.

- Ensure that children acquire movement skills that build towards more complex movements. These skills help lay the foundation for lifelong physical activity.
- Encourage basic movement skills — they do not just happen as a child grows older, but develop depending on each child’s heredity, activity experiences, and environment. For children with a disability, access to age and disability appropriate adapted equipment is an important contributor to success.
- Focus on improving basic movement skills such as running, jumping, twisting, wheeling, kicking, throwing, and catching. These motor skills are the building blocks for more complex movement.
- Design activities that help children to feel competent and comfortable participating in a variety of fun and challenging sports and activities.
- Ensure that games for young children are non-competitive and focus on participation.
- Because girls tend to be less active than boys and children with a disability less active than their peers, ensure that activities are gender-neutral and inclusive so that active living is equally valued and promoted for all children.



FUNdamentals

Age: males 6-9; females 6-8

Objectives

Learn all fundamental movement skills and build overall motor skills.

Skill development in the FUNdamentals stage should be well-structured, positive, and FUN!

The first window of accelerated adaptation to speed occurs at ages 6 to 8 for girls and 7 to 9 for boys. Bypassing the specialized skill development in the FUNdamentals stage is detrimental to the child’s future engagement in physical activity and sport.

No periodization takes place; however, all programs are structured and monitored.

If children later decide to leave the competitive stream, the skills they acquire during the FUNdamentals stage will benefit them when they engage in recreational activities, enhancing their quality of life and health.

FUNdamentals To-Do List

- Practice and master fundamental movement skills before sport-specific skills are introduced.
- Emphasize the overall development of the athlete's physical capacities, fundamental movement skills, and the ABC's of athleticism: agility, balance, coordination, and speed.
- Teach appropriate and correct running, wheeling, jumping, and throwing techniques using the ABC's of athletics.
- Emphasize motor development to produce athletes who have a better trainability for long-term sport specific development.
- Introduce basic flexibility exercises.
- Develop speed, power, and endurance using games.
- Encourage participation in a wide range of sports.
- Develop linear, lateral, and multi-directional speed with the duration of repetitions less than 5 seconds.
- Include strength training exercises using the child's own body weight as well as medicine ball and Swiss ball exercises.
- Ensure that sporting and disability equipment are size, weight, and design appropriate and that communities explore ways to share and provide access to appropriate equipment.
- Introduce children to the simple rules and ethics of sports.
- Ensure that activities revolve around the school year and are enhanced by multi-sport camps during summer and winter holidays.
- Participate once or twice a week if children have a preferred sport, so long as there is participation in many other sports 3 or 4 times per week to ensure future excellence.



Learning to Train

Age: males 9-12; females 8-11

Objective

Learn overall sports skills.

One of the most important periods of motor development for children is between the ages of 9 and 12. This is a window of accelerated adaptation to motor co-ordination.

Early specialization in late specialization sports can be detrimental to later stages of skill development and to refinement of the fundamental sport skills.

At this stage, children are developmentally ready to acquire the general sports skills that are the cornerstones of all athletic development.

Learning to Train To-Do List

- Further develop all fundamental movement skills and teach general, overall sports skills. Otherwise, a significant window of opportunity is lost, compromising the ability of the young player/athlete to reach full potential.
- Develop strength using exercises that incorporate the child's own body weight as well as Medicine balls and Swiss balls.
- Introduce hopping and bounding exercises or routines, or wheeling up gradients, to aid in strength development.
- Further develop endurance through games and relays.
- Further develop flexibility through exercises.
- Further develop speed by using specific activities that focus on agility, quickness, and change of direction during the warm-up.
- Structure competition to address differences in training age and abilities.
- Identify sports the child enjoys and is predisposed towards success. Narrow the focus to 3 sports.
- Introduce single periodization noting that some sports such as swimming and tennis need to use double periodization to adequately address the sport's unique needs.
- Apply a ratio of 70 per cent training to 30 per cent competition. The 30 per cent ratio includes competition and competition-specific training. These percentages vary according to sport and individual specific needs. Athletes undertaking this type of preparation are better prepared for competition in both the short- and long-term than those who focus solely on winning.
- Encourage unstructured play.

Training to Train

Age: males 12-16; females 11-15
(age ranges are PHV dependent)



Objectives

Build an aerobic base, develop speed and strength towards the end of the stage, and further develop and consolidate sport specific skills.

During Training to Train, young athletes consolidate their basic sport-specific skills and tactics. This is a window of accelerated adaptation to aerobic, speed, and strength training.

Optimal aerobic trainability begins with the onset of PHV, the major growth spurt during maturation.

During competitions, athletes play to win and to do their best, but the major focus of training is on learning the basics as opposed to competing.

Training to Train To-Do List

- Make aerobic training a priority after the onset of PHV while maintaining or further developing levels of skill, speed, strength, and flexibility.
- Emphasize flexibility training given the rapid growth of bones, tendons, ligaments, and muscles.
- Consider the 2 windows of accelerated adaptation to strength training for females: the first occurs immediately after PHV and the second begins with the onset of menarche. For males, there is 1 window and it begins 12 to 18 months after PHV.

Note that both aerobic and strength trainability are dependent on the maturation levels of the athlete. For this reason, the timing of training emphasis differs depending on whether athletes are early, average, or late maturers.

- Learn to cope with the physical and mental challenges of competition.
- Introduce athletes with a disability to sport-specific equipment such as wheelchairs and athletic prostheses. For all athletes, the use of body-size and skill-level appropriate equipment remains important.
- Optimize training and competition ratios and follow a 60:40 per cent training to competition ratio. Too much competition wastes valuable training time and conversely, not enough inhibits the practice of technical/tactical and decision-making skills.

- Use talent identification to help athletes focus on 2 sports.
- Utilize single and double periodization as the optimal framework of preparation.
- Train athletes in daily competitive situations in the form of practice matches or competitive games and drills.

The Learn to Train and Training to Train stages are the most important stages of athletic preparation. During these stages, we make or break an athlete!



Training to Compete

Age: males 16-23 +/-; females 15-21 +/-

Objectives

Optimize the engine and learn to compete.

Optimize fitness preparation and sport-, individual-, and position-specific skills as well as performance.

All the objectives of Training to Train must be achieved before the objectives of Training to Compete can begin.

Training to Compete To-Do List

- Provide year-round, high intensity, individual event, and position-specific training.
- Teach athletes, who are now proficient at performing basic and sport specific skills, to perform those skills under a variety of competitive conditions during training.
- Place special emphasis on optimum preparation by 'modelling' high competitions in training.
- Individually tailor to a greater degree fitness programs, recovery programs, psychological preparation, and technical development.

- Emphasize individual preparation that addresses each athlete's individual strengths and weaknesses.
- Select 1 sport.
- Utilize single, double, and triple periodization as the optimal framework of preparation.
- Change the training-to-competition and competition-specific training ratio to 40:60. Devote 40 per cent of available time to the development of technical and tactical skills and improving fitness and 60 per cent of training to competition and competition-specific training.

Training to Win

Age: males 19 +/-; females 18 +/-



Objective

Podium performances.

Maximize fitness preparation and sport-, individual-, and position-specific skills as well as performance.

Training to Win is the final stage of athletic preparation.

All of the athlete's physical, technical, tactical (including decision-making skills), mental, and personal and lifestyle capacities are fully established and the focus of training has shifted to the maximization of performance.

World class able-bodied and disability sport performances require world-class equipment that is fine-tuned to the demands of the event and the requirements of the athlete.

Training to Win To-Do List

- Train athletes to peak for major competitions.
- Ensure that training is characterized by high intensity and relatively high volume.
- Allow frequent preventative breaks to prevent physical and mental burnouts.
- Utilize single, double, triple, and multiple periodization as the optimal framework of preparation.
- Change the training to competition ration 25:75, with the competition percentage including competition-specific training activities.



Active for Life

Age: This may occur at any age

The age of transition from competitive sport to lifelong physical activity

Objective

A smooth transition from an athlete's competitive career to lifelong physical activity and participation in sport.

Canada's sport system should encourage athletes to

- move from one sport to another. For example, the gymnast becomes an aerial skier, the sprinter takes up bobsledding, or the 12-year-old basketball player discovers canoeing.
- move from one aspect of sport to another. For example, the middle distance runner becomes a guide runner for blind athletes or the cyclist rides tandem at the Paralympic Games.
- move from competitive sport to recreational activities such as hiking and cycling.
- move from highly competitive sport to lifelong competitive sport through age group competition such as Master's Games.
- upon retiring from competitive sport, move to sport-related careers such as coaching, officiating, sport administration, small business enterprises, or media.
- move from competitive sport to volunteering as coaches, officials, or administrators.



A positive experience in sport is the key to retaining athletes after they leave the competition stream.

Sport must make a paradigm shift from cutting athletes to re-directing them to sports where they are pre-disposed to train and perform well.



Impact of LTAD

On Parents

Few adults who were physically inactive as children become active as adults. Inactive adults tend to produce inactive children and the reverse is also true. Encouraging children to enjoy moving and promoting confidence in movement skills at an early age helps to ensure later participation in physical activity.

LTAD will

- provide a framework for parents to understand physical literacy and its implications on a healthy lifestyle through lifelong physical activity and on competitive sport involvement for all Canadians, including those with a disability.
- facilitate the understanding of physical, mental, cognitive, and emotional development.
- facilitate the understanding of special requirements such as proper hydration, nutrition, and recovery for the growing child.
- enable parents to help children to choose a pathway in physical activity and sport.



On Coaching

To be successful, an athlete development model such as LTAD requires highly skilled, certified coaches who understand the stages of athlete development and the various interventions that should be made.

LTAD will

- have a significant impact on the coaching education curriculum.
- have a significant impact on sport specific coaching education by NSOs.
- identify a need for part-time and full-time coaches who will specialize in coaching developmental athletes.

On Clubs and Community Sport and Recreation

Canada's sport clubs and community centres provide broad opportunities for participation and are essential to the successful implementation of LTAD from playground to podium.

LTAD will

- identify the need for programs to deliver LTAD.
- inform and educate staff and parents about the benefits of LTAD.
- align programs with schools, clubs, and community sports.
- rationalize the competition system at the national and provincial levels and in clubs, community sport, and recreational activities.

On the Sport System

The Canadian Sport Policy contains four goals: that a significantly higher proportion of Canadians from all segments of society are involved in quality sport activities at all levels and in all forms of participation; that the pool of talented athletes has expanded and athletes and teams are systematically achieving world-class results at the highest levels of international competition through fair and ethical means; that the essential components of an ethically based, athlete/participant-centred development system are in place and are continually modernized and strengthened as required; and the components of the sport system are more connected and coordinated as a result of the committed collaboration and communication amongst the stakeholders.

These goals can be achieved through the system-wide implementation of LTAD.

LTAD will

- signal radical changes to the structure and delivery of programs.
- cause realignment or rescheduling of competition calendars.
- provide clear pathways for progression.
- help athletes attain higher and more sustained levels of success.
- provide athlete-centred planning and decision making.
- provide a basis on which to monitor and evaluate the effectiveness of programs.
- provide a framework so that all stakeholders understand their role in programming interventions at each stage.

On Sport Science

Canada's sport scientists play a vital role in helping athletes and coaches to keep pace with international competition by contributing to their understanding of the science behind their sport's techniques. Sport scientists have an important role in developing new methodologies and monitoring sport science innovations around the world for continuous improvement of Canada's sporting techniques.

LTAD will

- encourage research into all aspects of LTAD, including
 - physical development.
 - mental/cognitive development.
 - emotional development and trainability and readiness factors
 - appropriate level of competition for all stages.
 - length of the competitive phase for all stages.
- establish normative data for all the stages of LTAD.



On the Education System

There is growing recognition of the urgent need for Canada's school children to become much more physically active. It is imperative that the education system assumes a prominent role in addressing the significant health problems that arise from an inactive lifestyle.

LTAD will

- highlight the need for daily quality physical education.
- highlight the need to improve training for teachers in the elementary schools to understand the concept of physical literacy and LTAD and correctly model and teach fundamental movement skills and sports skills.
- encourage new courses at colleges and universities to ensure that educators and coaches are familiar with physical literacy and LTAD and can apply these when teaching and coaching.
- encourage the establishment of sport academies and Sport-Étude programs enriching the training environment during the Train to Train phase.



Implementation

Canadian Sport Working Together

Giant steps forward have been taken by the federal, provincial, and territorial governments in endorsing the concept of LTAD. The same level of support must also come from municipalities, recreation centres, schools, and clubs.

Acceptance of LTAD provides the basis on which future development of athletes is planned and implemented.

To implement LTAD, the following actions need to be completed:

- Develop a general Canadian LTAD to enhance the understanding and acceptance of LTAD to help change the culture of Canadian sport.
- Implement sport-specific LTAD models in each sport. Where appropriate, include LTAD for athletes with a disability.
- Review coach education in each sport and overall, based on LTAD factors and objectives.
- Review competition structures and schedules in each sport and overall, based on LTAD factors and goals.
- Promote the development by all sports of the full range of motor and sport skills at the FUNdamentals and Learning to Train stages.
- Develop information on the Active Start and FUNdamentals stages for use across all sports in all communities.
- Incorporate FUNdamental activities into sport-specific sessions for younger children, especially during warm-up and fun activities.
- Promote greater co-operation between sport organizations, coaches, and teachers in the scheduling of sessions and competitions.
- Formulate a cross-sport declaration on the implementation of LTAD that is supported by multi-sport and sport-specific organizations.

Summary

LTAD

- is a philosophy and a vehicle for change.
- is athlete-centred from a child's first involvement in sport to the transition to lifelong physical activity or other sport related activities.
- integrates the needs of athletes with a disability into the design and delivery of sport programs.
- provides a framework for reviewing current practices, developing new initiatives, and standardizing programs.
- establishes a clear development pathway from playground to podium and on to being active for life.
- identifies the shortcomings in Canada's sport system and provides guidelines for problem solving.
- provides guidelines for planning for optimal performance for all stages of athlete development.
- provides key partners with a coordinated structure and plan for change.
- identifies and engages key stakeholders in delivering change.
- provides an aligned and integrated model for delivering systems including
 - long-term athlete development — technical, physical, tactical, and behavioural.
 - long-term coaching development.
 - sport and physical activity programs and services in NSO's, PSO's, recreational organizations, clubs, and schools.





Stratagem

WHITEFACE

NOKIA

State Farm

NOKIA

NOKIA

WHITEFACE

State Farm

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Appendix 1

Physical, Mental and Cognitive, and Emotional Development Characteristics

The following *Moving Scales* provide a guideline on how to utilize the Physical, Mental, Cognitive and Emotional Development Characteristics tables, pointing out the overlaps at the various stages of LTAD.



Late Childhood - Physical Development

Basic characteristics	General impact on performance	Implications for the coach
Heart size is increasing in relation to rest of body.	Endurance capacity is more than adequate to meet the demands of most activities.	Understand that the child has the capacity to keep going.
Anaerobic system is not developed.	There is a limited ability to work anaerobically.	Plan short duration anaerobic activities. The ability to hold breath must be practiced and built up gradually.
A child's metabolism is less economical than an adult's.	Children use more oxygen whether it's expressed in absolute values or prorated for body weight.	Do not expect younger children to keep up with older children.
Large muscle groups are more developed than smaller ones.	The child is skilful in movement requiring the use of the large muscle groups.	Emphasize the development of general motor skills involving the large muscle groups. Then gradually introduce more precise, co-ordinated movements requiring the interaction of smaller muscle groups.

Basic characteristics	General impact on performance	Implications for the coach
Children have a shorter tolerance time for exercise in extreme temperatures.	Children may show symptoms of overheating or hypothermia more quickly.	To acclimatize children will take longer so longer warm-ups may be required. Watch closely for signs of distress caused by extremes of temperature.
Children subjectively feel able to be active in the heat before physiological adaptation has occurred.		Postpone or restrict exercise in heat or humidity and ensure that plenty of fluids are ingested. Thirst is not a good indicator of fluid need.
Motor patterns become more refined and the balance mechanism in the inner ear gradually matures.	Great improvement in agility, balance, co-ordination, and flexibility occurs towards the end of the stage.	Emphasize co-ordination and kinaesthetic sense when doing activities. Balance in the water using buoyancy aids is one way to develop these abilities.
Strength develops by the improvement in the neural pathways.	There is apparent improvement in strength not brought about by the neuro-muscular adaptations of muscle fibres.	Plan coordination activities.

Late Childhood - Mental and Cognitive Development

Basic characteristics	General impact on performance	Implications for the coach
The attention span gradually increases.	Children cannot listen or stay still for long periods.	Provide short and precise instructions. Devise strategies to ensure children are listening. Children learn well by imitating and practicing correctly-modelled movements.
Children are enthusiastic and often impatient.	Children want to move and not listen.	Do not bombard children with technical information. Give only sufficient detail for the activity to be undertaken. Keep the fun.
Children have very limited reasoning ability.	Children love to be led.	Direct the training and give it a tight focus with activities that are fun and well planned. Introduce imaginative ways of achieving performance goals.

Basic characteristics	General impact on performance	Implications for the coach
Children enjoy the repetition of activities and improve through experience.	Skill learning must be directed; children do not learn correctly just by trial and error.	Provide correct demonstrations of the basic sport skills. Personal demonstrations must be accurate.
Children establish their preferred learning style.	Learning is through verbal, visual, or manual means. Most children are doers!	Use a variety of learning styles to suit individual needs.
Imagination is blossoming.	Creativity should be encouraged.	Allow the children to play and experiment. Use their ideas to create exciting sessions. Structure to encourage individuality and creativity. Sport provides an excellent vehicle for expression.
Language skills may be limited but are improving.	Children can't make corrections to their performance unless they understand what is being asked of them.	Use terminology that can be easily understood. Gradually introduce technical terminology. Children love long words.

Late Childhood - Emotional Development

Basic characteristics	General impact on performance	Implications for the coach
Children like to be the centre of attention.		Develop this characteristic. Plan activities that guarantee success. Always move from simple to more complex when teaching a skill movement. Allow children to show their skills.
Children are developing their self concept.	Children tend to evaluate their performance as a whole and in terms that may be black and white. (I was brilliant, or, I was useless.)	Provide positive reinforcement to build self- esteem. Children are likely to perform the actions again if they are successful and feel good about it. Build on success.
Children feel secure with a routine and structure to training.	Introduce change sensitively and gradually.	Build a structure that is progressive but maintains continuity.
Children feel secure when coaching is constant.	Children like things to be fair.	Set and maintain high levels of expectancy, but be consistent with each child. Do not let mood swings or personal situations change coaching behaviours.

Early Adolescence - Physical Development

Basic characteristics	General impact on performance	Implications for the coach
Significant proportional changes occur in bone, muscle, and fat tissue.	Athletes may temporarily lose some of their kinaesthetic awareness, their ability to 'know where they are'.	Because athletes will need to constantly change their positions, monitor carefully to ensure appropriate adaptations are being made.
Different parts of the body grow at different rates. Arm and leg length increases before the trunk.	Athletes may appear gangly and lose control of their extremities.	Make athletes aware of the effect of their changing body shape. Skills already refined may need to be re-learned.
Decreases in flexibility result directly from growth.	Movement may become restricted.	Emphasizes low stretching exercises.
Increases in growth and decreases in flexibility make adolescents prone to injury from acute impact.	Injury can result from exercise of an acute nature such as forced elongation of muscles during kicking and jumping or from overuse.	Vary land-based activities and activities to avoid overuse.
Girls begin their growth spurt between 10 and 14 years and grow at very different rates.	Athletes are very different sizes at the same age.	Be aware that age-related groupings may not be appropriate.
There is a significant increase in the production of red blood cells.	The oxygen transportation system is improved.	Introduce structured aerobic training to make the most of these changes. Only short duration anaerobic training is recommended.
The central nervous system is almost fully developed.	Agility, balance, and co-ordination are fully trainable.	Use this period for maximum improvement in skill development.
Abstract thinking becomes firmly established.	Adolescents should be part of decision-making processes and be more responsible for their decisions.	Base decision making for strategies on skill level.
A new form of egocentric thought develops.	The result may be a strong fear of failure.	Plan for success. Introduce coping strategies, including mental imagery.
Young people are eager to perfect their skills.	Structure successful skill learning based on individual needs.	Build on success. Be aware that athletes develop at very different rates and although early developers make early progress, include all athletes. Be aware that late developers may have greater potential.

Early Adolescence - Emotional Development

Basic characteristics	General impact on performance	Implications for the coach
Physical, mental, and emotional maturity may not develop at the same time.	Athletes who look mature may not act it. Confusion or anxiety may arise.	Develop communication skills and understanding.
Tensions may arise between adults and adolescents.	Adolescents need help to cope with their physical and emotional changes.	Ensure two-way communication channels are always open. Allow athletes input into the decision making.
Hormonal activity increases.	Athletes may experience mood swings and behaviour may change.	Communicate and accept changes, but don't let hormonal changes be an excuse for negative behaviour.
Social interaction between males and females becomes important.	Athletes want to form friendships and it is important to allow time for them to develop positive relationships.	Try to organize social events that allow social interaction.

Late Adolescence - Physical Development

Basic characteristics	General impact on performance	Implications for the coach
Post-menarche height begins to stabilize. Increase in height is about 5%. Stabilization of muscular system also occurs.	Muscles have grown to mature size, but increases in muscular strength continue into the 20s.	Maximize strength training to bring about overall improvement. Optimize neuromuscular training.
Skeletal maturation continues.	Connective tissue is strengthening.	Continue progressive overloading in training.
By 17, girls have generally reached adult proportions.	Girls proportionately gain more weight during this period.	Optimize aerobic training. Be aware of how to deal with weight gains. Teach athletes how to compete in varied circumstances.
Rate of improvement in motor ability declines.	Rate of improvement in skill development declines.	Be aware that the rate of improvement in motor ability will be slower, but improvement will still be made.

Late Adolescence - Mental and Cognitive Development

Basic characteristics	General consequences for performance capabilities and limitations	Implications for the coach
Generally by 16, the brain has reached adult size, but continues to develop neurologically.	Athletes can understand the technical requirements of their sport.	Make sure athletes understand why they are doing certain things.
Critical thinking becomes more established.	Athletes can make decisions about their training pathway.	Allow athletes input and reduce the amount of feedback and make athletes think for themselves. Develop awareness of performance by increasing kinaesthetic knowledge.
There should be complete understanding and acceptance of the need for rules, regulations, and structures.	Rules are seen in simplistic terms and must be clear and well defined.	Always be seen to be fair because adolescents have a strong sense of fairness in making decisions. Make athletes part of the decision-making process.

Late Adolescence - Emotional Development

Basic characteristics	General impact on performance	Implications for the coach
Major decisions about examinations, universities, and employment work have to be made.	There are 'pulls' on time and energy.	Build in prophylactic breaks. Be aware of external pressures. Seek professional guidance to ensure the correct career and educational pathway.
Peer group pressure leads to conflicting loyalties.	An athlete may give up sport because of peer pressure and the need to be seen as one of the gang.	Be sensitive in goal setting to ensure that common goals are established and met.
Self-actualization and self-expression are important.		Treat athletes as adults. Share goals and work co-operatively towards them. Maintain a coach-led structure.
Interactions with friends of both sexes continue to be a strong priority.		Allow time to establish independent social interaction.

Early Adulthood - Physical Development

Basic characteristics	General impact on performance	Implications for the coach
Physiologically, the body reaches maturity during this stage.	All physiological systems are fully trainable.	Ensure that physical training programs employ the most advanced techniques and sport science information to facilitate maximum adaptation and minimize injuries.
		Ensure that all muscle groups and body alignments are well-balanced, complemented with optimum flexibility ranges.
		Use state-of-the-art testing and monitoring programs.
		Carefully monitor overtraining and overstress.
Final skeletal maturation in females occurs at about 19-20 years and in males about 3 years later.		Organize regular medical monitoring Schedule additional blood tests for females in case of anemia.

Early Adulthood - Mental and Cognitive Development

Basic characteristics	General impact on performance	Implications for the coach
Neurologically, the brain matures about 19-20 years of age.	Athletes are capable of self-analyzing and correcting and refining skills. Athletes can analyze and conceptualize all facets of their sport.	Establish winning as the major objective.
	Well-developed information processing skills improve the athlete's ability to visualize verbal instructions.	Implement principles of adult learning.
There is a complete understanding and acceptance of the need for rules, regulations, and structure.	The young adult must perceive the rules and structure as being clearly defined and fair.	Involve athletes in decision making and planning team or group activities.

Early Adulthood - Emotional development

Basic characteristics

General consequences for performance capabilities and limitations

Implications for the coach

There is a need to be self-directed and independent.

Athletes are ready to assume responsibility and accept the consequences of their actions.

Emphasize goal setting to give definite direction and purpose to the athlete's overall program.

Self-actualization and self-expression are important.

Treat athletes as adults and with respect. Remember that the coach's direction and structure remain important.

Major decisions on career, education, and lifestyle are priority at some point in this stage.

Major changes in interests, hobbies, and physical activities occur.

Make professional guidance available, considering off-season and educational pursuits.

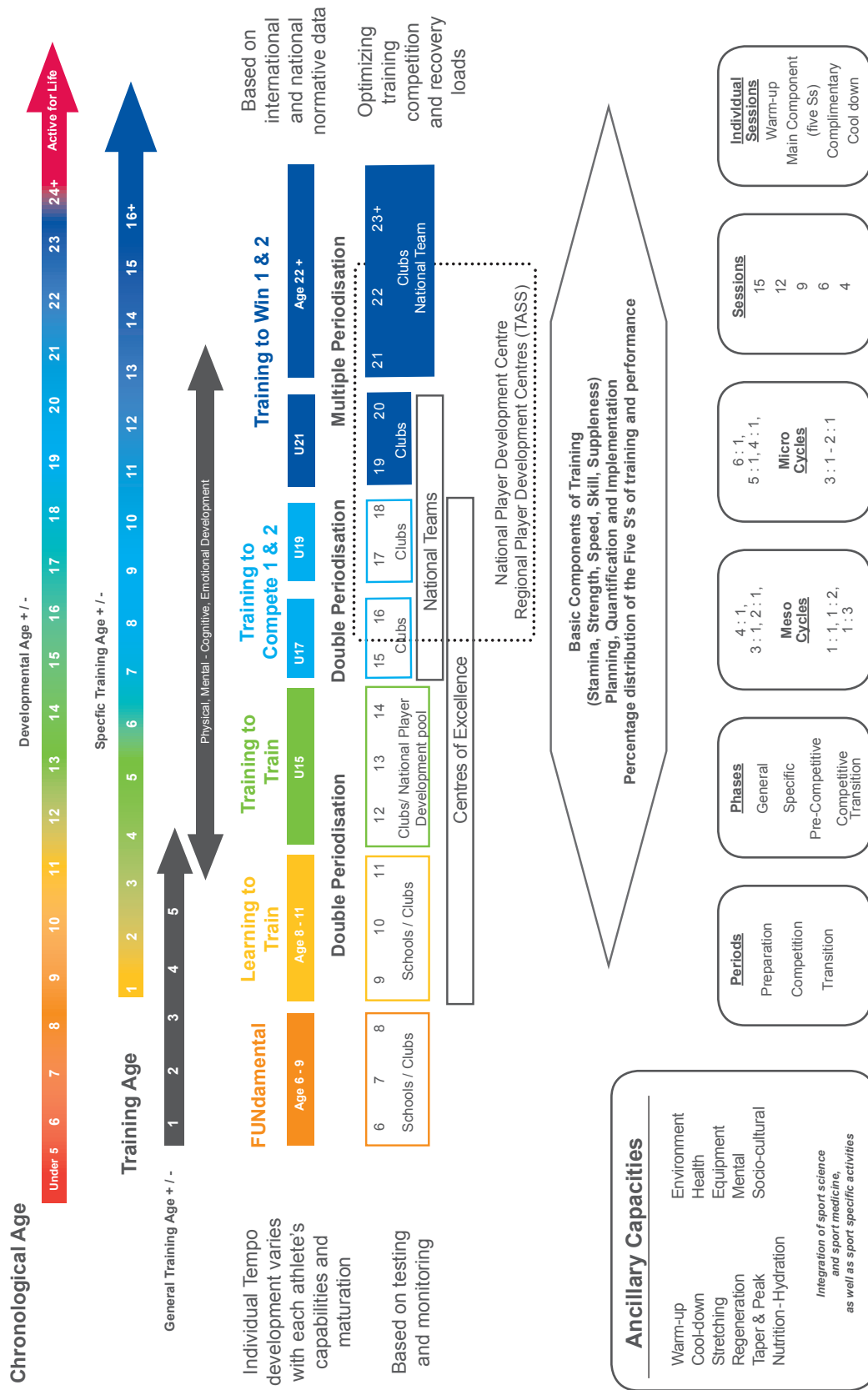
Interactions with the opposite sex continue to be a strong priority with lasting relationships developing.

Provide athletes with ample opportunities for independent social interaction.

Appendix 2

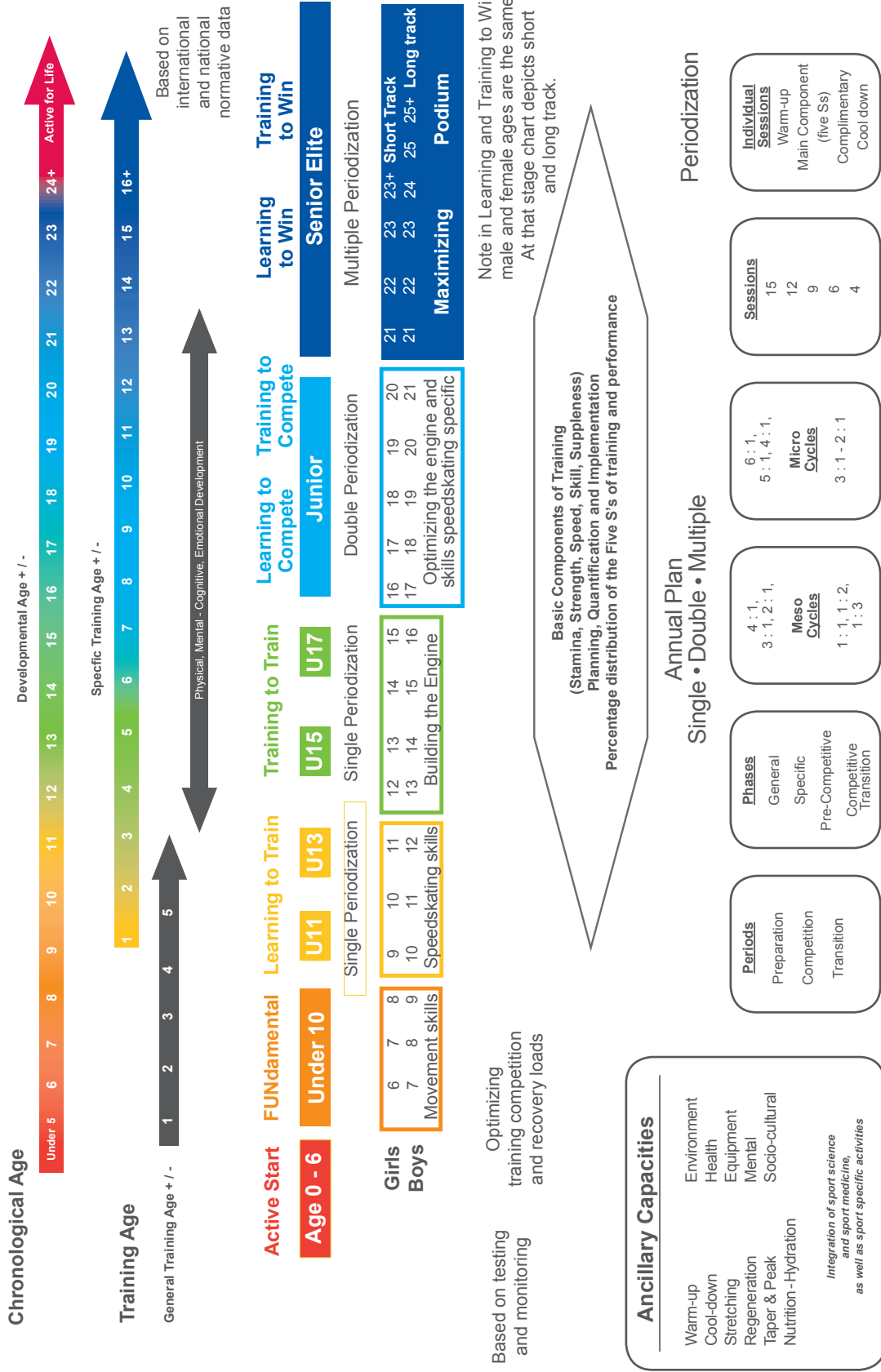
Sport Specific Charts

English FA Women's Soccer - Long-Term Athlete Development - Periodization (Balyi, Hills, Simmons and Way 2005)



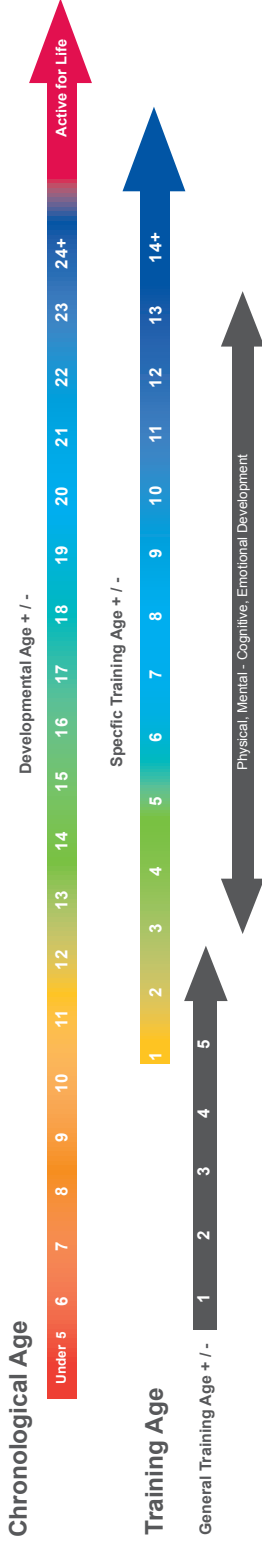
Long-Term Athlete Development Plan - Speed Skating

(Way, Holmik and Balyi 2005)



Canadian Curling Association - Long-Term Athlete Development - System

(Dagg-Jackson, Balyi, Soligo and Way 2005)



Female	Male	Learn to Play Age 6 - 8 Age 6 - 9	Learning to Train Age 8 - 11 Age 9 - 12	Training to Train 11 - 15 12 - 16	Training to Compete 1 & 2 15 - 17 16 - 18	18 - 20 18 - 20	21 - 25 21 - 25	Age 26 + Age 26 +													
6	7	8	9	10	11	12	13	14													
Active in all Sports	Club awareness programs	Getting Started in Curling	Kids Curl (Fundamentals)	Clubs Teams	School Teams	Bantam Competitions	Canada Games	School Competitions	National U 18 Development	Reg. / Prov. Development Programs	National Jr. Development Programs	Junior Competitions	Sport Centre Regional Rep. Teams	Uni/College Teams	Reg. / Prov. Development Programs	National Jr. Development Programs	Open Competitions	Sport Centre	Clubs Programs	Prov. and Nat. Team Programs	Le Revele Advanced
Individual Tempo development varies with each athlete's capabilities and maturation	Based on international and national normative data	Based on testing and monitoring																			

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