



*Long-Term  
Athlete Development Plan  
CanoeKayakCanada*



*May  
2006*





*CanoeKayak*  
**Canada**

***[www.canoekayak.ca](http://www.canoekayak.ca)***

We acknowledge the financial support of the Government of Canada through Sport Canada, a branch of the Department of Canadian Heritage.

Nous reconnaissons l'appui financier du gouvernement du Canada par l'entremise de Sport Canada, une direction générale du ministère du Patrimoine canadien.

**Canada**<sup>11</sup>





## Table of Contents

<i>Foreword</i>	7
<i>Introduction</i>	8
<i>Why does Canoe/kayak need an LTAD Model?</i>	8
<i>The Ten Key Factors Influencing LTAD</i>	9
<i>Trainability</i>	11
<i>Stages of LTAD for Canoe/Kayak</i>	13
<i>Active Start</i>	15
<i>FUNDamentals and Foundations</i>	15
<i>Training to Train</i>	18
<i>Learning to Compete</i>	21
<i>Training to Compete</i>	23
<i>Training to Win</i>	25
<i>Active for Life</i>	26
<i>Practical Implications</i>	28
<i>Implementation</i>	30
<i>Conclusion</i>	30
<i>Glossary of Terms</i>	31
<i>Bibliography</i>	32







# Foreword

by Anne Merklinger, Director General, CKC

What is long term athlete development? Why should CKC be spending time and energy developing a long term athlete development Model? What are the implications of the long term athlete development Model for paddling? These are questions that have and will continue to be asked as CanoeKayak Canada fully implements our long term athlete development Model over the coming years.

Long term athlete development (LTAD) is a concept that has evolved through recognition that there are gaps in athlete development, talent identification, athlete recruitment and athlete retention in the Canadian sport system. LTAD is a planning tool for optimal performance for all stages of athlete development. It is based on empirical data, practical coaching experiences and scientific principles and is a framework for full sport system alignment in Canada, integrating health and education with sport and physical activity.

Paddling is a sport that has been led by a knowledgeable, competent and experienced group of professional coaches and dedicated volunteers who have achieved success in the sustained development of athletes throughout all stages of the athlete development Model. To ensure that CanoeKayak Canada continues to be successful, we have developed a LTAD Model that will help align all aspects of paddling across Canada. The proposed LTAD Model is a framework that provides paddlers at all stages of development the opportunity to be the best they can be. It will ensure that paddlers are equipped with the fundamental building blocks required to progress. The LTAD Model will serve as a guideline for athletes, coaches, parents and volunteers at every level of paddling. Whether a paddler has their sites set on the Olympic podium, Club championship or just wants to have fun on the water in a non-competitive environment, LTAD is about giving every paddler the chance to achieve their ambitions and realize their dreams.

Full implementation of our LTAD Model will have implications for paddling in Canada. Reflections in this LTAD Model reinforce some of our current programs and activities. Some of the reflections suggest changes would be beneficial. In order for CKC to have success at all levels, we must embrace a more systematic approach to athlete development. Thank you to the following expert group of coaches, scientists and sport leaders who have contributed to the drafting of the CKC LTAD Model:

Istvan Balyi  
Drayton Coolen  
Peter Giles  
Mac Hickox  
Krzysztof Lepianka  
Dave Robertson  
Jerome Seremak

Graham Barton  
Mike Creamer  
Mark Granger  
Frederic Jobin  
Don McKenzie  
Kenna Robins  
Leo Thornley

Tamas Buday Sr.  
John Edwards  
Joel Hazzan  
Csom Latorovszki  
Scott Oldershaw  
Lesley Ann Schmidt  
Penny Werthner

*"As a developing athlete, my coaches encouraged an intense but highly social program that kept our training group hungry for more work, and eager to take on new challenges. We worked hard, but in an environment with a lot of variety, where fun was always a major priority. Success came easily to our group as we made the transition to international competition because another challenge was just what we were looking for."*

**Adam van Koeverden**  
**Olympic Champion**



## *Introduction*

Long Term Athlete Development (LTAD) is a plan for athletes to maximize their potential through optimal training, competition, and recovery techniques throughout their athletic careers. In addition, LTAD is about enjoying life-long participation in canoe/kayak and other physical activity. Training, racing, and recovery programs are based on an athlete's developmental age rather than chronological age and are designed to optimize development during critical periods of maturation and trainability. LTAD also takes into account the physical, mental, emotional, and cognitive development of all participants.

Canoe/Kayak has been identified as a late specialization sport, which means that most competitors will not achieve their maximum potential until their mid-twenties. This means that athlete development is a long term process. A solid foundation of movement skills and fitness is critical for everyone, especially athletes participating in late-specialization sports. In order to reach their maximum potential, canoe/kayak athletes need to build physical literacy as children – the mastering of fundamental movement skills and fundamental sport skills – by participating in a wide variety of sports and physical activity when they are young. Early specialization in canoe/kayak can harm long term development.

LTAD also contributes to health and a life-long enjoyment of canoe/kayak and other physical activity. LTAD defines a clear, seamless development pathway. It gives coaches, administrators, Clubs, and others involved a clear understanding of how they can best support the athletes for whom they are responsible. It gives athletes a clear idea of what they need to do and when they need to do it in order to excel at the elite level. There are 7 stages that make up the Canoe/Kayak LTAD Model, the final competitive stage being Training to win, however that is not to say that this is the only stage where competition and success should occur. We want to develop a framework that will allow athletes to be successful at every stage.

## *Why does Canoe/kayak need an LTAD Model?*

The recent and past success of Canadian paddlers on the international scene suggests that we are doing a lot of things right. For example, our younger athletes train more than they compete; and our Club structure permits athletes to learn critical boat skills at a young age by allowing them to mess around in boats before, during and after structured practices. However, a clearly defined Long Term Athlete Development Plan will establish a clear and consistent development pathway for canoe/kayak, guide the examination of the current system to identify strengths, gaps, and inconsistencies; guide coaches in planning training, racing, and recovery programs that are consistent with the principles of growth and maturation, allow athletes to achieve optimal performances, and encourage them to stay in the sport for life; and help Canadian paddlers to perform better and more consistently at the elite level from year to year.







# The Ten Key Factors Influencing LTAD

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

## 1. The 10-year Rule

Scientific research has identified that it takes approximately 10 years and 10,000 hours of training for a talented athlete to reach elite levels. There are no shortcuts; athlete development is long-term process. Short-term performance goals must not be allowed to undermine long-term athlete development.

## 2. The FUNDamentals

Fundamental movement skills – agility, balance, co-ordination – and fundamental sport skills – running, jumping, throwing, kicking, catching, and swimming – are the basis for all other sports. Children should develop these skills before the onset of their growth spurt in adolescence. An individual who is not competent in the basic movement skills will have difficulty participating in a range of sports and will have fewer opportunities for athletic success and life-long enjoyment of physical activity.

## 3. Specialization

Canoe/Kayak is a late-specialization sport. We depend on other components of the sport system such as schools, recreation centres, and other sports, in addition to our own programs, to provide children with opportunities to develop physical literacy and early speed and suppleness (during the Fundamentals and Foundations Stage). Athletes need to participate in a variety of sports and physical activity during the FUNDamental and Foundations stage in order to succeed in a late-specialization sport. Specializing early in a late specialization sport can contribute to limited skill development and deficiencies in basic physical literacy leading to injuries, early burnout & early retirement.

## 4. Developmental Age

LTAD is based on developmental age, not chronological age. We all follow the same stages of development from early childhood through adolescence, but the timing, rate, and magnitude of development differs amongst individuals. During late childhood and adolescence, athletes who are the same chronological age may be four to five years apart developmentally. Coaches need to understand these developmental differences and take them into account when they design training programs and select athletes.

## 5. Trainability

All physiological systems are always trainable, but there are critical periods in development when the body is particularly responsive to specific types of training. To reach their genetic potential, athletes need to do the right type of training at the right stage. Athletes who miss these windows of trainability can still compete at the highest level, but it will require more time and effort for them to enhance these capacities to the same level as those who did the right training at the right time. For a more in depth look into the windows of trainability. (please see the section below entitled trainability).

## 6. Physical, Mental, Cognitive, & Emotional Development: A Holistic Approach

Coaches should consider the whole athlete. At each stage, coaches should consider the emotional, mental, and cognitive development of each athlete, in addition to their physical development, when they plan training, racing, and recovery programs.



## **7** *Periodization*

Periodization provides the framework for organizing training (for example, mode, volume, intensity, frequency of training), racing, and recovery into a logical and scientifically based schedule in order to achieve optimum performance at the required time. A periodization plan that takes into account growth, maturation, and trainability principles should be developed for each stage of athlete development.

## **8** *Calendar Planning for Competition*

The regatta system and calendar should support and be consistent with LTAD. Different stages of development have different requirements for the type, frequency, and level of competition. At some stages of development (for example, Training to Train), training and development should take precedence over formal racing and short-term success. At later stages, it becomes more important for athletes to experience a variety of competitive situations and to perform well at high-level regattas.

## **9** *System Alignment and Integration*

LTAD recognizes that physical education, school sports, recreational activities, and competitive sports are interdependent. For example, as a late-specialization sport, canoe/kayak depends on schools, recreation centres, and other sports to provide children with opportunities to develop physical literacy and early fitness. LTAD recognizes that enjoying a lifetime of physical activity and achieving athletic excellence are both built on a foundation of physical literacy and fitness. All elements of the sport system must be integrated and aligned with one another to achieve these goals. Similarly, all parts of the Canadian canoe/kayak system – Clubs, Divisions, provincial associations, CKC, and regattas – across all regions, must be integrated and aligned with one another. Each element in the system plays a crucial role in athlete development. For the system to work well, they must be mutually supportive, clear in their roles and responsibilities, and clear in how they contribute to the “bigger picture” of athlete development. Just as the athletes in a fast crew must integrate and align their movements, the components of the canoe/kayak system must integrate and align their activities. Canoe/Kayak athletes will do best in a paddling (and sport) system that is clear, seamless, and based upon a consistent set of principles. LTAD allows paddlers to identify the opportunities available to them and to understand the pathway they need to follow. If they want to paddle at an elite level, they will know (in general terms) what type of training, racing, and recovery they should be doing at each stage, when they should start to specialize in paddling, and what they need to do to move up through the system. They (and their parents) will have the knowledge to advocate for programs, coaching, equipment, regattas, and other services that will support their long-term development. In a system where the various elements are integrated and aligned, paddlers will be less likely to “fall through the gaps.”

## **10** *Continuous Improvement*

LTAD is based on the best available scientific research and empirical evidence, but knowledge and understanding evolve. LTAD should respond to, integrate, and, in some cases, stimulate research and canoe/kayak-specific innovations.



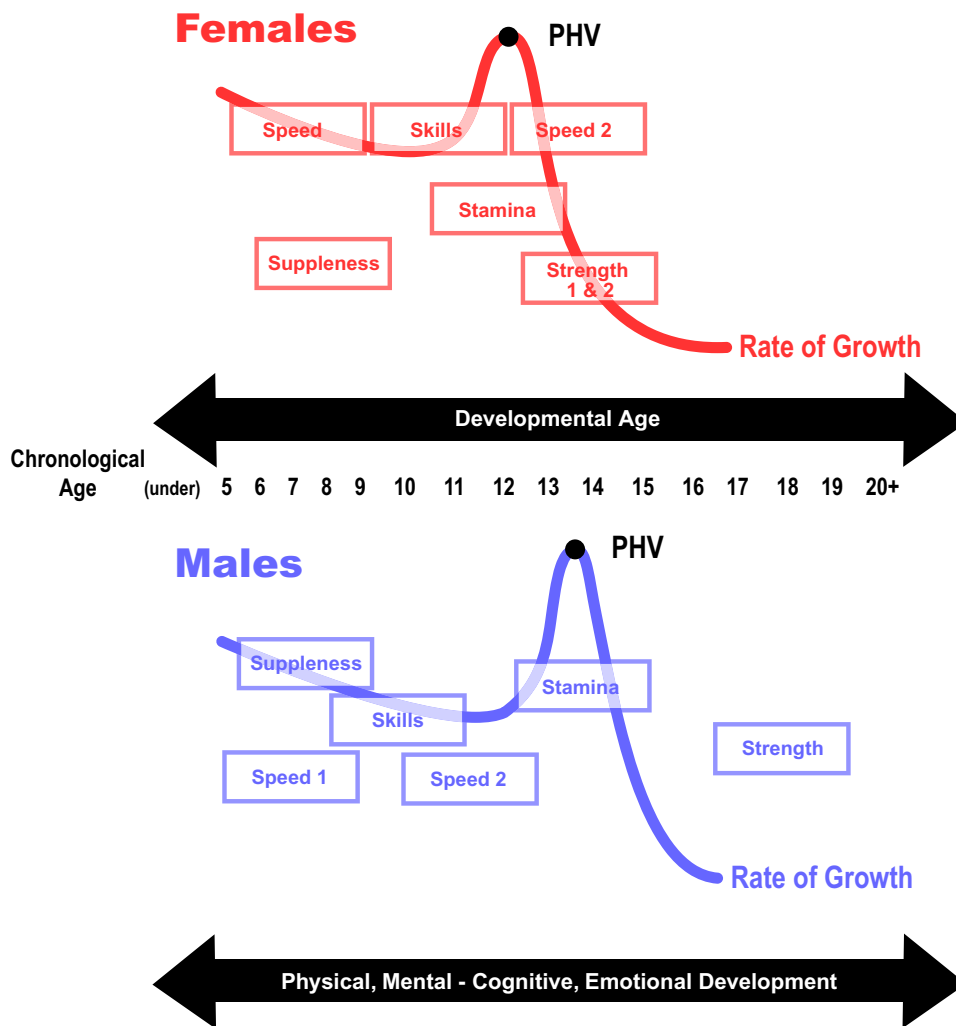


# Trainability

Trainability refers to how responsive an individual is to a training stimulus at different stages during growth and maturation. Although all physiological capacities are always trainable, there are critical periods in the development of a specific capacity during which training has the most effect. These are referred to as “critical windows of accelerated adaptation to training.” Correct training during these critical windows is essential for individuals to achieve their genetic potential. Scientific evidence shows that humans vary considerably in the magnitude and rate of their responses to a given stimulus. This variability underlines the need for a long-term approach to athlete development, so that athletes who respond slowly are not short-changed. Sport scientists have identified five physical capacities (the five S’s of Training and Performance): Stamina, Strength, Speed, Skill, and Suppleness. For stamina and strength, the critical periods of trainability are based on developmental age; specifically, the onset of the adolescent growth spurt. For speed, skill and suppleness, the critical periods of trainability are based on chronological age. Note that, on average, girls reach these windows of trainability at a younger chronological age than boys.

The following chart illustrates the windows of Trainability relative to growth and maturation:

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





*Trainability con't..*

### *Speed*

There are two critical periods for trainability of speed. During the first speed window, training should focus on developing agility and quickness; during the second speed window, training should focus on developing the anaerobic alactic energy system.

For girls, the first speed training window occurs between the ages of six and eight years and the second window occurs between the ages of 11 and 13 years. For boys, the first speed training window occurs between the ages of seven and nine years and the second window occurs between the ages of 13 and 16 years.

### *Suppleness (Flexibility)*

For both girls and boys, the critical window of trainability for suppleness occurs between the ages of six and 10. In addition, special attention should be paid to flexibility during PHV.

### *Skill*

For girls, the window for optimal skill training occurs between the ages of eight and 11 years; for boys, it occurs between the ages of nine and 12 years. During this window, children should be developing physical literacy; that is, competence in the fundamental movement and sport skills that are the foundation for all sports. Competence in these skills makes it easier for children to learn and excel in late-specialization sports such as canoe/kayak.

### *Stamina (Endurance)*

The critical window of trainability occurs at the onset of Peak Height Velocity (PHV), which is the adolescent growth spurt. Athletes should focus on aerobic capacity training as their growth rate accelerates; aerobic power should be introduced progressively after growth rate decelerates. Aerobic capacity and power are crucial for canoe/kayak athletes.

### *Strength*

For girls, there are two critical windows of trainability for strength: the first is immediately after PHV and the second is at the onset of menarche. For boys, there is one strength window and it starts 12 to 18 months after PHV.



# Stages of LTAD for Canoe/Kayak

The LTAD framework outlined below describes the optimal development pathway for an athlete who starts paddling between 6 and 12 years of age and continues through to racing successfully at the elite level. The early stages of development will be the same for all paddlers. When the volume of training starts to increase during the Learning to Compete Stage, the pathway of those who choose to compete at a high level will diverge from those who choose to paddle and compete for enjoyment and fitness. Any training, racing, and recovery program should reflect the goals of the paddler for whom it is designed.

## Stages of Long-Term Athlete Development for Canoe/Kayak



# Long-Term Athlete Development Framework for Canoe/Kayak

	Active Start	FUNDamentals & Foundations	Training to Train	Learning to Compete	Training to Compete	Training to Win	Active for Life
<b>AGE</b>	0 - 6	6 to 11 6 to 12	11 to 15 12 to 16	13 to 15± 14 to 17±	15 to 23± 17 to 23±	23±	anytime
<b>PHASES</b>	FEMALES MALES						
<b>Skill Development</b>	Fundamental Movement Skills	Fundamental Sport Skills; Canoe/Kayak Skills	Physiological Development	Continued Physiological Development; Competitive Development	Competitive Development	Performance	Health
<b>TRAINING FOCUS</b>		basic paddling skills; balance & boat control	intermediate paddling skills	gross motor refinement; advanced paddling skills; technique under race conditions	technical refinement; refinement of decision making skills;	technical maintenance; refinement of raceplans; performance management	goal specific
<b>CRITICAL WINDOWS OF TRAINABILITY</b>		FUN/ Play Skill development	General Endurance	Sport Specific Endurance; Strength; Speed		Improve & Maintain Strength, Speed, Endurance + Ancillary Capacities	Fitness, Fun, Well Being
<b>VOLUME OF TRAINING</b>		Speed 1 Suppleness Basic Skills	Speed 2 Aerobic Capacity Strength Females 13 - 17 Males 14 - 19				
<b>Mental Preparation</b>		3-5 sessions/week; progressing to 4-6 sessions/week	in-season: 4-8 sessions/week off-season: 4-6 sessions/ week	in-season: 8-12 sessions off-season: 6-9 sessions	9-12 sessions/week year round	individualized	goal specific
<b>Monitoring</b>		build desire to stay involved; build self confidence	develop focus; effective goal setting; breathing & relaxation skills; athlete/coach communication & feedback	focusing & re-focusing; effective goal setting; assessing training & competition; visualization; relaxing vs. energizing	continually refining mental skills; developing 'correct level of intensity'	attention to detail; managing distractions	
<b>REGATTAS</b>		aerobic capacity; agility; flexibility; height	aerobic capacity; flexibility; height	aerobic capacity; height; general strength	aerobic power & capacity; anaerobic power & capacity; sport specific strength	aerobic power & capacity; anaerobic power & capacity; sport specific strength	general well-being
		Club	Divisional	Interdivisional/Provincial	National	International	



## Active Start

**Age: 0-6 years**

### Objective:

Learn fundamental movements and link them together into play.

### Key Outcomes: *Fun and Movement skills*

Physical activity should be fun and a natural part of every child's daily life. Active play is the way young people are physically active. CKC does not play an active role in this stage other than recommending that children learn to swim, and play in boats with their parents as a part of developing physical literacy.

---

## FUNdamentals & Foundations

**Age: Males 6-12; females 6-11**



### Objectives:

At the beginning of this stage the objectives are to learn overall sport skills; build water sense and safety awareness; and learn basic boat and paddle handling skills in age appropriate sprint canoe and kayaks.

### Key Outcomes:

At the end of this stage, children will:

- **Be physically literate (competent in fundamental movement skills)**
- **Possess fundamental canoe kayak skills**
- **Use the canoe/ kayak basic boat steering skills in demonstrating boat control**
- **Paddle continuously in a single and team boat**
- **Be comfortable and confident in boats and playing in, on, and around the water**
- **Be able to swim 25m with a PFD.**



CKC promotes an active role at this stage with the Canoe Kids Day Camp program as well as the atom and peewee programs. Children at this age are at the optimal point to learn basic skills; therefore the objectives of the atom and peewee programs should be the introduction and continued learning of the basics (balance, steering, and propulsions) in all types of appropriate canoes and kayaks. In addition to participating in these programs, parents should be encouraged to paddle with their children. This will help children master the basic



skills. In addition it strengthens the family atmosphere that surrounds and supports the Canadian Club system. To help develop other basic sport skills, as well as coordination and body awareness, children should be enrolled in other sporting activities three to four times per week. Developing physical literacy requires a broad base of activities such as athletics, swimming, gymnastics, etc. For example the Run, Jump Throw program offered by Athletics Canada for participants in this age group is a good example.

- **Technique:** Athletes at this stage should focus on learning how to balance and properly control all types of canoes and kayaks; there is no need at this age to specialize in canoe or kayak. By the end of this stage, athletes should be able to set up the body properly in the boat, be able to stay in stroke and be able to properly hold a paddle in both canoes and kayaks. Athletes should be able to properly steer a sprint canoe and kayak. By the time athletes reach the end of this stage they must have good fundamental canoe and kayak skills.
- **Tactical:** In this stage, children should engage in deliberate play and should learn basic decision making skills such as how to dock a boat properly, how to avoid hazards in the water, and judging weather conditions for safety reasons. Children should also learn to launch and dock a boat, listen and follow instructions, and learn to paddle in a group. Toward the middle of the stage, athletes should be starting to make decisions on the race course such as properly lining up, starting, and propelling their boat down the course.
- **Equipment:** At this stage of development athletes will require stable boats, but by the end of the stage they should be using an intermediate style racing canoe or kayak. *Therefore, Clubs should have a good progression in boats* from very stable to newer style racing boats. Kayakers should be using seats, but the seats should sit as low as possible in the boat to maximize stability. As the athlete grows, longer and bigger blades can be used, but not at the expense of good technique. Young children should be exposed to a variety of equipment. Importantly, throughout this stage children should be taught to be responsible and careful in the use of fragile boats, paddles and other equipment.
- **Coaching:** Coaches will require a good knowledge of growth and development as well as knowledge of the fundamental movement skills and fundamental sport skills that make up physical literacy. They should have the ability to assess physical literacy and make recommendations to the children to improve any gaps. Coaches who are dealing with athletes at the start of this stage (CanoeKids) should have CanoeKids training (community coach course) whereas coaches who are training athletes that are nearing the end of this stage should be ELCC trained and certified.





- **Training Volume:** At the start of this stage, children who are not in a day camp setting should be participating in 3-5 sessions per week lasting 30-120 minutes. The session should include a warm up; work on general technical skills; modified games or activities with simple rules and a cool-down. Towards the end of this stage they should continue to do 3-5 sessions per week lasting 90-120 minutes with more of an aerobic fitness component included. Nevertheless, kids should be encouraged to 'hang-out', and 'horse around', in, and under boats. Throughout this process they are learning critical paddling skills.
- **Competition:** Children in the CanoeKids program do not participate in Divisional regattas, but can be invited to informal Club regattas combined with the atom athletes. The regattas should be a half day in length and should be 'unlimited fun' (Jamboree style, see FUNDamentals stage) culminating with a Bar-B- Q at the end of the event. The athletes should compete in stable boats and both canoes and kayaks. In addition, coaches should start developing team boat skills and team boat races should be part of all regattas. There should be no championship regattas in small boats for this age group. Athletes nearing the end of this stage can start competing in head to head style competitions tailored towards their developmental needs. The length of the regatta can be increased to a one day event and these athletes may race 3-4 times per year in local, Divisional and inter-Divisional competitions. However, these athletes should continue to race in both canoes and kayaks, and team boat events should be stressed. Finally, even though the level of competition has increased these regattas should continue to be fun for the athlete and they should be recognized for their achievements by handing out medals or ribbons on a podium at the end of the day.



- **Mental Preparation:** The main objective at this level is to create an environment where the children want to paddle, enjoy being on the water, learning early skills on how to paddle. Coaches need to clearly understand the importance of such a social environment and have the skills to create it. They need to be skilled at teaching the basic skills (because even though at this level, the 'athletes' are young, they still will begin to build confidence by 'improving' in the sport. There needs to be a variety in the training, again so the young athletes-to-be want to continue. A key point here is building desire to stay involved and building self-confidence. Some suggestions are movies on Olympic Heroes (motivation), kilometre charts or personal improvement recognition, games to foster team play. All of this will create a foundation upon which the coach and the athlete develop a long term productive relationship.
- **Nutrition:** Children at this age should be made aware of proper hydration. They can also be taught about nutrition through analysing the snacks they bring to the Club and be encouraged to make healthy choices. Coaches can also use informal talks to inform athletes and parents on healthy choices. Clubs should be encouraged to provide healthy snacks during regattas.



- **Monitoring:** During this stage many children will start their growth spurt, especially females. This is known as peak height velocity (PHV). Since PHV is used as a marker for many of the critical windows of trainability, height should be measured a minimum of 4 times per year. This stage also coincides with the critical windows for suppleness and speed I (agility); therefore it is suggested that a simple flexibility test such as the “Sit and Reach Test” be used to monitor hamstring and low back flexibility; and a shuttle run test to monitor agility. Finally, although endurance is not one of the critical windows of trainability listed in this section, it is still a very important measure of general health and wellbeing and can be used as a benchmark for future improvement. CKC suggests using a simple field test such as the Cooper test or the Leger test to measure endurance.
- **Safety:** CKC recommends a coach to athlete ratio of 1:10. In addition, all children enrolled in these programs should wear life jackets when on the dock or in the water. It is also a requirement that coaches follow the CKC Code of Safety and have first aid and CPR.
- **Ancillary Capacities:** By the end of this stage, children and parents should be educated about proper clothing and equipment at practice (hat, water bottle, sunscreen, change of clothing) and they should be aware of how to properly warm-up and cool down for practice and races; callisthenics, stretching, jogging.

## Training to Train

*(Learning to paddle & ‘building aerobic machines’)*

**Age: Males 12-16 years; Females 11-15 years**

### Objectives:

- **build general endurance**
- **learn to paddle with proper technique**
- **develop speed and strength**
- **Proficiency in paddling singles and crew boats (technical template)**
- **Speed**



### Key Outcomes:

*At the end of this stage athletes will have developed:*

- **A strong aerobic base (2km times; 1500m times; 300m swim times; template; measurable)**
- **Core strength**
- **Specialize in canoe or kayak towards the end of the stage**



CKC currently plays an active role in the development of athletes at this stage through the delivery of the peewee, bantam and midget racing programs. This stage encompasses many different windows of trainability for both males and females as most athletes will begin, and some may complete PHV during this stage. The first training window will likely be the second speed window for both males (13-16 years) and females (11-13 years). This speed window should focus on the development of anaerobic alactic power and capacity through the use of 0-20 second intervals with lots of rest. The onset of PHV will signal the start of the aerobic capacity window. Athletes at this age should start doing some dryland aerobic training to supplement on-water aerobic training in order to avoid over use injuries. Finally, the onset of menarche for females will signal the start of strength training window, however since males normally reach their growth spurt after females, males will not likely reach this window during this stage as the onset of the strength window for males is 12-18 months after PHV.

- **Technical:** By the end of this stage of development, athletes should be specializing in either canoe or kayak. Athletes should be getting into more advanced technique (see comp dev templates). By the end of this stage athletes should be competent in all racing craft. Athletes should also be able to adapt their technique to accommodate varying race conditions. Coaches are advised to assess balance frequently and make sure the athletes are using the proper equipment. Advancing an athlete too quickly into a more advanced racing boat will result in poor balance making it more difficult for the athlete to master technique.
- **Tactical:** During this stage athletes should be introduced to the various aspects of racing such as pacing, assessing stroke rate, and washriding for long distance competitions without the help of a coach. They should also be introduced to race plans for the various distances and practicing their race preparation warm-up plans.
- **Equipment:** Boat progression should correlate with balance and maturation; athletes should be mastering their technical skills in stable boats before they progress into competitive racing boats. Athletes should also be responsible for their equipment and know how to properly take care of it.
- **Coaching:** Coaches who are instructing at this stage should be minimum ELCC certified and continue with on going professional development. All coaches working with athletes at this stage of development should have a thorough knowledge of the growth and maturation stages (physical literacy). The coach will be acting as a teacher, a leader and a facilitator to athletes and parents.
- **Training Volume:** As mentioned above there are up to 3 critical training windows that occur during this stage (speed #2, aerobic capacity, and strength). Each of these windows should be emphasized at the appropriate time during this phase, in addition to the other training components. CKC recommends that during the paddling season athletes in this stage should be training a minimum of 4-8 times per week on water and each session should consist of 60-90 minutes of activity (structured and unstructured). Since this stage is crucial for the development of the aerobic system, dryland





training can be introduced as well to supplement on water training. It is important to note that 4 sessions has been chosen as the minimum because anything less than that is simply maintenance work. During the off season, athletes at the start of this stage should be participating in other complimentary sporting activities (swimming, cross-country skiing, cross-country running, and gymnastics to name a few), but at the same time Clubs should offer 1-4 session per week of canoe/kayak specific training so they do not lose touch with their athletes. By the end of this stage athletes should be moving more and more into sport specific training and Clubs should offer 4-6 training sessions per week during the off-season

- **Competition:** Athletes at the beginning of this stage are ready to participate in formal competitions. This stage reflects the speed window and the aerobic capacity window therefore, competition should reflect these windows. It is important for the development of the athlete that they race both short and long distance races. As athletes progress through this stage they should start being exposed to increasingly competitive style regattas. Athletes nearing the end of this stage should be competing at the National Championships. As the athlete progresses through this stage, more and more major and minor competitions will be available for the athlete to compete in; CKC recommends that the athlete only compete in one major competition per season and one minor competition per month. This is not to say that athletes should only go to one regatta per month, but rather that local Club regattas should tailor their race cards to emphasize skill development instead of traditional head to head races
- **Mental preparation:** This age group is ready to learn what to focus on and how to develop that skill. In doing this, they will begin to understand/can be taught that what they think and feel affects their performance; and, how to develop 'control' over those thoughts and feelings. They can also learn how to set effective goals at a number of different levels; outcome, performance, process, and its relationship to the skill of focus. In addition, athletes should be introduced to breathing and relaxations skills. Finally, it could also be appropriate to begin to teach the athletes how to communicate effectively with their coach(es) and how to ask for feedback.
- **Nutrition:** In addition to proper hydration and food choices, athletes in this stage should be aware of proper pre-race and race day foods as well as the timing of snacks and meals throughout the day in relation to practices and races. This information can be provided through coach information or through lunch cards.
- **Monitoring:** Almost all children will have reached their growth spurt during this stage, therefore it is very important to measure height at least four times per year to monitor PHV. In addition, rapid growth generally results in losses in flexibility, so the "Sit and Reach Test" should also be employed here to monitor hamstring and lower back flexibility. Finally, during this stage athletes should be working on general endurance, so the 'Cooper test' or the 'Leger test' also be used as a means to monitor endurance during this stage.
- **Safety:** The volume of training is increasing at this stage, therefore athletes should be introduced to basic injury prevention ideas such as stretching (when and how), and various recovery techniques (stretching and ice). Cold water paddling rules should be followed in early spring and late fall.
- **Ancillary Capacities:** At this stage of development athletes should be responsible for doing a proper warm-up and cool down as part of their practice and should be developing warm-up routines for race day. Towards the end of this stage they should be introduced to the concept of tapering, but a shorter taper should be used to avoid detraining. Athletes should also be aware of the importance of proper nutrition for training and on race day.



# Learning to Compete

*(learning to race)*

**Age: Males 14-17 years; Females 13-15 years**



## Objectives:

- **Refine and consolidate paddling skills**
- **Learn to race**
- **Develop sport specific endurance, strength, speed and skills for racing**

## Key Outcomes:

At the end of this stage athletes will have developed:

- **Proficiency in singles, doubles and fours under a variety of conditions**
- **Confidence in a variety of regatta and race situations (including seat racing and time controls)**
- **Good decision-making skills with regard to all aspects of training and boat handling**
- **Appropriate and measurable improvements of sport-specific endurance, strength and speed**

This is a critical stage where biological maturation has a strong influence on training and it is essential to measure PHV to determine when the various training windows occur. The second speed window for girls will occur at the beginning of this stage between the ages of 11 and 13, and the same window for boys occurs between the ages of 13 and 16. The aerobic capacity window occurs with the onset of PHV for both sexes and the strength window occurs with the onset of menarche for females and 12-18 months after PHV for boys.

## Training Focus:

- **Technical:** At this stage the athletes should be looking to improve and understand their technique through kinaesthetic sensation (feel) and a variety of feedback from the coach. It is essential that the athlete's good technique transfers to the boat in terms of good boat propulsion. The athlete should also learn to transfer their technique to racing.
- **Tactical:** Athletes should experiment with race plans and pacing strategies for all distances.
- **Equipment:** By the end of this stage athletes should have their own personal equipment; singles and paddles. At the end of this stage athletes should be able to paddle in the most current shapes of racing singles, doubles and fours; use of the ultimate technology of paddles. Athletes should be able to adjust equipment to personal settings.
- **Coaching:** Coaches training athletes at this stage should be a fully certified ELCC and mentored by a competition development coach. They should also consider taking the competition development certification, carry on with coaching education, and consider taking various professional development courses.





- **Training Volume:** Athletes at this stage should be specialized in canoe or kayak and this should be their main sport focus throughout the summer. During the competitive season these athletes need to be doing 8-12 sessions per week. During the general preparation period these athletes should be doing 6-9 canoe/kayak specific training sessions per week of 60-90 minutes each. By the end of this stage, athletes should be introduced to training camp environments. Athletes should be introduced to heart rate versus effort, heart rate versus speed, and their relation to stroke rate.
- **Competition:** Athletes in this stage should be competing in 4-7 events per season. Half the events should be designed as traditional regattas where crews can practice and perfect their race plans for the major competitions. One of the regatta's should be a crew boat only regatta that focus on the



development of crew boat skills and two regattas should be long distance to emphasize the aerobic capacity window that occurs in this stage. Athletes in this stage are ready to compete in two major regattas per year, one being the National Championships and the other a provincial team trials. After the competitive season there should be an active recovery period lasting a minimum of two weeks.

- **Mental preparation:** During this stage all the psychological skills need to be taught/learned; what to focus on and how to train it; how to re-focus if you lose it; how to set various goals (process, performance, outcome; and how/why each are important, but how they can also be stressors); understanding and learning how to relax for sleep, and within a competition; how to energize and how to recognize when it is necessary; how to set up effective plans for training and for competition; how to assess each of the above skills on a regular basis (after competitions, at the end of the year); how to visualize effectively (not an easy skill for many athletes). The order in teaching and learning of these skills will depend, to a degree, on the athlete's needs.
- **Nutrition:** Athletes will refine nutritional skills and strategies which include pre and post training and racing. Self analysis and awareness of food choices and bring in professionals to group setting. THE EVALUATION OF THE DIET.
- **Monitoring:** As in previous stages, height should be monitored four times per year in this stage to monitor PHV. In addition, this stage corresponds to the aerobic capacity window, thus a general field test for aerobic power and capacity should be used such as the Leger Test or the Cooper Test. This stage also corresponds with the strength window, thus a general strength test such as FITEX should be used to monitor progress.
- **Safety:** The athlete should be fully aware of the safety requirements of the sport including appropriate equipment and procedures for all kinds of weather conditions. This includes Club, regional and national policies and regulations.
- **Ancillary Capacities:** By the end of this stage athletes should not only be doing proper warm-ups and cool downs, but should also know the reason why they are doing these things. Initiate learning the basics of health and wellness and be responsible for injury prevention and rehab.



# Training to Compete

*(taking responsibility as athletes & racers)*

**Ages: Males 17-23; females 15-23**



## Objectives:

- **Further develop and refine sport specific endurance, speed, strength and skills for racing in Olympic distances**
- **Further develop and refine racing skills including mental preparation, race strategies and ability to handle a variety of conditions and situations**

## Key Outcomes:

At the end of this stage athletes will:

- **Race well under a variety of conditions, maintaining good technique under pressure and fatigue**
- **Be empowered to understand their role in critical thinking and decision making for their training, performance, equipment, schooling, and social life under the guidance of their coach**
- **Manage their lifestyle to meet training commitments**

Athletes in this stage have completed all the objectives and outcomes from the previous stage and are ready to train at a national team level. Yet if necessary there should be opportunities for the athlete to receive remedial support in deficient areas. Athletes are working with their Club coach, national development team coach, national team coach and performance enhancement team. Athletes in this stage are often on the national team and working towards performing at a world class level.

- **Technique:** Maintain and refine trained technique as individualized progression continues. Athlete now learns to transfer technique to racing.
- **Tactics:** Athlete learns a variety of tactics and strategies in training that are applied during competition. Athlete is trained to critically think and make appropriate decisions in utilizing required tactics during competition. Coach and athlete identify tactical deficiencies and are implementing the required adjustments.
- **Equipment:** All equipment at this point should be personalized and meets national and international standards.
- **Coaching:** At this stage the coach athlete relationship is more of a partnership. Coaches at this level should have completed competition development and are continuing with professional development opportunities and National Team initiatives. Coaches should be participating in on going professional development workshops.



- **Training:** As athletes move through this stage they should be participating in an increased number of centralized training camps culminating in the athlete spending most of the competitive season with the respective National Team discipline coach, National Team development coach or provincial/regional team coach.



Training should be designed by the Club coach and monitored by the national team discipline coaches, national team development coach or provincial/regional team coach. National discipline coaches, National Team development coach and/or provincial/regional team coach should be establishing guidelines and monitoring technical, tactical, physiological and psychological expectations for their respective athletes.

- **Competition:** As athletes develop through this stage, they are training to compete at the national championships, Canada Cup, Canada Games, National Team Trials, Junior World Championships and international competitions associated with the national under 23 programs. To reflect their personal development within this stage, the coach and athlete select the appropriate number of minor competitions for “Modelling” their race plans in order to have the best possible performances during major competitions. Toward the end of this stage, athletes should be participating in 2-3 major competitions per year which includes National Team Trials and international competitions. To foster athlete development through this stage of CKC’s LTAD the Junior Division of the National Championships is for under 21 athletes in the singles competition. The Canada Games would also become a competition for athletes at the mid-point of this stage (21 years).
- **Mental Preparation:** By this stage, hopefully the athlete has developed all the skills mentioned in the learn to compete stage, and now he/she should be continually refining these skills and developing the ‘correct level of intensity’ for within the demands of the sport (this latter piece is the final piece of the puzzle, and again, not an easy one.).
- **Nutrition:** Athletes should be working with a nutritionist to identify any deficiencies and make the required adjustments.
- **Monitoring:** Athletes in this stage require more specialized monitoring due to the higher physical demands associated with higher levels of training. Athletes should be receiving annual physicals and regular blood analysis as part of the monitoring process outlined by the team physician and exercise physiology team. Athletes should be receiving sport specific aerobic power and capacity as well as anaerobic power and capacity tests as part of the monitoring process throughout the year. Sport specific strength testing should be done as part of the yearly testing outlined by the team physician and performance enhancement team. The results of the testing should be used to make individualized training recommendations for each athlete to help improve performance.
- **Safety:** Athletes abide by seasonal and local regulations in their training (apply to all stages).
- **Ancillary Capacities:** Identify any deficiencies and make the required adjustments.





# Training to Win

*(racing fast and racing fast consistently)*

## Objectives:

- **Refine individual training, technique and racing skills so athletes have the greatest potential to win.**
- **Maintain or where possible, improve technical, physical, racing and ancillary capacities**



## Key Outcomes:

At the end of this stage athletes will produce:

- **Podium performances by winning medals at World Championships and Olympic Games**
- **Athletes will continue to race consistently at the podium level for more than one quadrennial cycle.**

Athletes at this stage are national team members at the peak of their careers who have previous experience in World or Olympic finals. They are working closely with their personal coach, national team coach, and performance enhancement team. All relevant performance capacities have been met and training programs are refined to address their individual strengths and weaknesses. Most athletes do not medal until the end of this stage.

- **Technique:** Refine and reinforce technical excellence.
- **Tactics:** Identify competition strategies to ensure the greatest potential for podium performances. This includes refinements to raceplans, and performance management.
- **Equipment:** Athletes and CKC should be working with equipment manufacturers to customize equipment for optimal performance.
- **Coaching:** At this stage the coach athlete relationship is more of a partnership in conjunction with national team coaches. Coaches are NCCP High Performance certified (NCCP 4 and/or 5) and participating in on going professional development workshops.
- **Training:** Athletes in this stage have made a full time commitment to year round training. Athletes are involved in national team training camps scheduled throughout the year (functional centralization). Fall training and “at home” training periods should be designed by the Club coach in consultation with the national team discipline coach. National discipline coaches should be establishing technical, tactical physiological and psychological expectations for their respective athletes.
- **Competition:** The competition schedule for train to win athletes should be constructed with the goal of achieving optimal performance at World Championships and Olympic Games. This means scheduling an appropriate number of selection/international competitions as a lead-up to the major competition.



- **Mental Preparation:**

Attention to detail in the training and performance environment by the athlete the coach and the team (managing distractions).

- **Nutrition:** Athletes, coaches and the team should be working with a nutritionist to identify any deficiencies and make the required adjustments.
- **Monitoring:** Athletes in this stage require more specialized monitoring due to the higher physical demands associated with the higher levels of training. Athletes should be receiving annual physicals and regular blood work as part of the monitoring process outlined by the team physician and exercise physiology team. In addition, athletes should be receiving sport specific aerobic power and capacity as well as anaerobic power and capacity tests as part of the monitoring process throughout the year. Sport specific strength testing should also be done as part of the yearly testing outlined by the team physician and performance enhancement team. The results of the testing should be used to make individualized training recommendations for each athlete to help improve performance.
- **Safety:** The inherent dangers of international competition.
- **Ancillary Capacities:** Identify any deficiencies and make the required adjustments. Communication is critical between the athlete and the performance team. Athletes are considered as leaders at this stage.



## Active for Life

**Age:** Any age

### Objectives:

- **continue to be physically active in paddling and/or other sports and activities.**
- **continue to be involved in the paddling community, as an athlete, coach, official or in other capacities.**

### Key Outcomes:

- **Health, well-being, and fun.**



The goal of this stage is to keep paddlers involved in the sport for life. Some people enter this stage from the competitive scene, while others may never have been competitive paddlers and just enjoy the recreational and fitness aspects of this sport. Regardless, athletes in this stage are valuable to Clubs to fill out crew boats, to act as coaches, and to be volunteers. Divisions may benefit from people in this stage as well by turning them into officials and volunteers on boards. Paddlers in this stage should be recognized as athletes and as leaders and resources for our sport.

- **Technique:** Develop or refine technique based on individualized goals.
- **Tactics:** Develop or refine tactics based on individualized goals.
- **Equipment:** Equipment should be matched to athlete's ability level and goals. Beginner athletes should use beginner equipment and more advanced athletes can progress into racing style boats and personalized equipment.
- **Coaching:** At this stage the coaches should be ELCC certified and able to communicate effectively with an adult population. In general, the coach will act as a teacher and an advisor to the athletes.
- **Training:** Training at this stage should be adapted to the athlete's individual goals. Consideration should be given for the athlete's age and past sporting experience when prescribing exercise.
- **Competition:** Athletes at this stage should compete in skill appropriate regattas at the Divisional level. Consequently, Divisions should be encouraged to remember the value of these athletes and create appropriate regattas when determining their regatta schedules. CANMAS is an excellent example of a regatta that creates the opportunity for everyone to race at every age and skill level.
- **Mental Preparation:** Athletes should be encouraged to enjoy the benefits of physical activity and a healthy lifestyle.
- **Nutrition:** Athletes should be following the guidelines set out in the Canada Food Guide for Healthy Eating.



- **Monitoring:** It is suggested that athletes at this stage consult their physician before starting a new physical activity program. In addition, Clubs should be encouraged to do some kind of pre-screening before prescribing exercise to this population.
- **Safety:** Athletes should be made aware that there are inherent dangers associated with all sport, and it is everyone's responsibility to minimize those dangers. Swimming ability should be assessed and PFD's should be worn by those who are not competent swimmers.
- **Ancillary Capacities:** Many athletes in this category may be new to physical activity therefore; they should be instructed about the benefits of regular physical activity, proper warm-up and cool down, stretching, proper hydration, and proper nutrition.

## Practical Implications

LTAD has practical implications for parents, coaches, Clubs, the regatta system, and equipment as well as for the optimal age for learning to paddle and the optimal way of learning to paddle. Together, the paddling community must build the environment that will allow LTAD to be effective. In some cases, this will demand a change in the way of thinking about athlete development; in some cases, LTAD will support and provide further impetus to coaches and Clubs who are already implementing changes based on the principles of long-term athlete development. LTAD is endorsed by Sport Canada and by the Federal-Provincial/Territorial Ministers Responsible for Sport, Physical Activity and Recreation. All sports in Canada will be developing LTAD plans and together will contribute to athlete development during the FUNdamentals, Learning to Train, and Training to Train stages.

- **Clubs:** Clubs are the backbone of canoe/kayak in Canada. Part of the current success of CKC is the 'Clubhouse culture' which exists at many Clubs; . Kids hanging out, horsing around, in and under boats. Throughout this process they are learning critical paddling skills. We think this is somewhat accidental but with an enormous benefit for our sport. In large part, the time spent 'playing in boats' is a critical part of the paddler's need to build the critical balance skills of the sport. The LTAD workshops identified the need for all Canadian Paddlers to have better canoe/kayak technical skills. This must start at the novice paddler level.



In addition, the critical windows of trainability for speed (first window), and suppleness, and part of the skill window occur before most children start paddling. We rely on schools, recreation centres, other sports, and parents to provide children with the correct training and opportunities to develop these capacities. Therefore, Clubs should consider building relationships with these organizations to advocate and support appropriate training.



- **Parents:** LTAD will provide a framework for parents to understand physical literacy and its importance for a healthy lifestyle and for success in competitive sport. It will help parents to understand physical, mental, cognitive, and emotional development and how these affect participation, training, and performance. LTAD will also help parents to understand the particular hydration, nutrition, and recovery requirements of growing children.
- **Equipment:** Clubs will need to provide appropriately sized boats and equipment for athletes as they move through the fundamentals and foundations stage. Smaller athletes will require smaller boats and paddles of the appropriate length and blade size. Paddles length should be based on the athletes sitting height and arm span, and refined based on the coaches observations on the water.
- **Regatta's:** Much of the literature on LTAD suggests that children in the Fundamentals and Foundations stage and in the Learn to Train stage, over compete and under train. Generally, in canoe/kayak the younger athletes train throughout the week and compete on most weekends of the summer during July and August. CKC believes there is nothing wrong with this; however where we need to be careful is in the nature of the competition. Club and Divisional regattas should focus on skill development not on head to head, win at all cost type races. In addition, the duration of events should match the physiological “windows of trainability”. This is not to say that only events of a certain duration will be raced in each “window”; it means that more emphasis would be put on events which capitalize on the “window”.
- There is also a restructuring required at the Training to Compete stage. The Canadian Championships and the Junior World Championships are very successful at providing incentives for the Midget and Juvenile age classes to continue with the sport; no additional incentives are required. However, there is a large drop off after the juvenile age class. This is partly due to societal influences, in particular, the end of high school and the beginning of post-secondary education. Nevertheless, the lack of a high profile competition after Junior Worlds and the long transition to the World Championships suggest that a new category and a high profile competition is needed for the 19 to 21 year old athlete. CKC recommends the following change to provide incentives for athletes to remain in the sport.
- Form a new Junior age class at under 21 for singles only, to retain post-secondary ‘B’ level paddlers and to provide another stepping stone prior to senior. (Note: A post-secondary age class might be the catalyst we need to get university and community college paddling Clubs going.)
- The Canada Games age should be changed to under 21 for the same reasons mentioned in the bullet above, with the additional emphasis that it would bring the CG directly in line with our HP system. (Note: Provincial support for CG would now start going to the next level of athlete in the HP stream. This would bring another 7 provinces x \$50k into the national HP program)
- **Coaches:** All CKC paddlers need to have better canoe and kayak technical skills at all levels. This requires expert skilled coaches at all levels. CKC is one of the leading NSO’s in developing the new NCCP courses that match the LTAD principles. Coaches should be encouraged to complete these courses and participate in on-going professional development sessions to continually improve their skills. Clubs and PSO’s should be seeking out ways to hire and maintain full time coaching positions at all levels, not just at the high performance level. CKC needs to establish nation-wide measurement protocols to establish national ‘normative’ data



## Implementation

The process leading up to development of this document has been the first stage in the implementation process. At the 2006 AGM of CKC-Sprint Discipline this draft will be presented for discussion. The LTAD working committee hopes that the AGM will endorse a support-in-principle motion for this LTAD Model. This will essentially permit the committee and staff to continue to the next step. This step will be the consultation with the each of the Divisions. Representatives of CKC will present the CKC LTAD Model and consult with each Division. Through this process, all of the Division's will be provided an opportunity to provide input on the LTAD Model. This consultation is expected to occur up until the end of 2006. In addition to providing input into the Model, these Divisional meetings will provide opportunities for Divisions to begin planning for any changes they may wish to incorporate into their 2007 activities and programs.

### *In subsequent steps, CKC intends to;*

- develop and describe in detail the training, racing and recovery programs for the Training to Train, Learning to Compete, Training to Compete and Training to Win stages of this document.
- prepare separate supporting documents that will communicate the principles of LTAD and provide specific guidance for coaches, athletes, parents, and Clubs.
- use LTAD to review the existing canoe/kayak system, and make improvements on any gaps and weaknesses in the system. The immediate priorities include a review of the regatta system; educating athletes, coaches, parents, and administrators on the theories and principles of LTAD; continued coach education; and the establishment of nationwide measurement protocols.



## Conclusion

This document is the first step in developing LTAD for canoe/kayak. It provides an overview of LTAD, defines the principles on which LTAD is based, outlines the framework of the stages and the key aims and elements of each stage, and highlights some of the practical implications for the Canadian Canoe/Kayak system. It has been an opportunity for us to assess how we do our business to ensure that all our participants have a positive and 'life-building' experience through their involvement with paddling. Whether a person is a Master, an Olympian or a Peewee, a consistent and well understood LTAD, will allow all CKC members to be part of a positive sport environment.



## Glossary of Terms

- ABC's: Agility, balance, coordination and speed
- CPK's: catching, passing, kicking and striking with a body part
- KGB's: Kinaesthetic sense, gliding, buoyancy, striking with an implement
- Major competition: Any competition that is the main focus of training for the year. The major competition may change depending on which developmental stage the athlete is in and usually involves peaking.
- Minor competition: Smaller competitions where athletes can practice their race plans and race day routines against most of the top competitors in their discipline. Usually involves some rest and or taper before the competition, but does not involve a major peak.
- Lead in competition: Small competition where athletes can practice their race plans and race day routines.
- Ancillary capacities: All the various other factors that can play a role in athlete preparation (warm-up, cool down, stretching, social, taper, nutrition).
- Functional Centralization: Flexible network of competition and training initiatives allowing coaches and athletes to optimize training and performance.
- Modeling: practicing race plans and competition scenarios
- Peak Height Velocity (PHV): The maximum rate of growth in stature during the growth spurt. The age of maximum velocity of growth is called the age at PHV.



## *Bibliography*

- Balyi, I. Sport system building and long-term athlete development in Canada. The situation and solutions, in *Coaches Report*, Summer 2001.Vol.8, No.1, pp.25-28.
- Balyi, I., Cardinal, C., Higgs, C., Norris, S., and Way, R. *Canadian Sport for Life: Long Term Athlete Development Resource Paper*. Canadian Sport Centres. 2005.
- Bar-Or, O. (ed). *The Child and the Adolescent Athlete*. Blackwell Science Ltd. Oxford, UK, 1996.
- Bloom, B. *Developing Talent in Young People*. New York: Ballantines, 1985.
- CanoeKayak Canada. *Canoe Kids*. Ottawa, ON.: CanoeKayak Canada, nd.
- Ericsson, K.A. and Charness, N. *Expert Performance. Its Structure and Acquisition*. American Psychologist, August 1994., pp.725-747.
- Malina, R.M. and Bouchard, C. *Growth, Maturation, and Physical Activity*. Champaign, Ill.: Human Kinetics, 1991.
- Robertson, S. and Way, R: *Long-term Athlete Development: A Madein- Canada Model*. *Coaches Report*, Vol.11. No.3, pp. 6-12.
- Rushall, B. *The Growth of Physical Characteristics in Male and Female Children*. In *Sports Coach*, Vol.20, Summer, 1998. pp.25 - 27.
- Sample, B. *Its Gotta Be Fun!: Sport Psychology and the Young Paddler*. Ottawa, ON.: Canadian Canoe Association. 1984.
- Sanderson, L. *Growth and Development Considerations for the Design of Training Plans for Young Athletes*. Ottawa: CAC, SPORTS, Vol.10. No.2. 1989.
- Scammon,R.E. *The Measurement of the Body Childhood*. In Harris et.al., eds. *The Measurement of Man*. Minneapolis: University of Minnesota Press. 1930.
- Stafford, I. *Coaching for Long-Term Athlete Development*. The National Coaching Foundation, Coachwise, Leeds, 2005.
- Viru, A, Loko, J., Volver, A., Laaneots, L., Karlesom, K., and Viru, M. Age periods of accelerated improvements of muscle strength, power, speed and endurance in age interval 6-18 years. In *Biology of Sport*, Warsaw, V., 15 (4) 1998, 211-227 pp.



