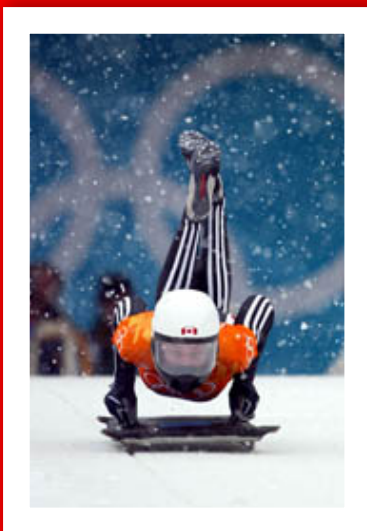


BOBSLEIGH CANADA SKELETON  
LUGE CANADA

# CANADIAN SLIDING SPORTS Long-Term Athlete Development



*Sliding to Success.....*

## *Introduction*

### ***The Evolution of a Canadian Slider:***

Canada has long been an active, winter sport nation, and sliding/sledding is organic to its history and its recreation. What was once a necessary means of transportation to navigate mountainous terrain quickly became a means to fun and excitement. When it snows, one can safely expect local parks and hills to be dotted with both children and adults alike seeking the thrill of racing downhill on any number of makeshift or more advanced sleds. Canadians love to slide and slide often, so it is only natural that competitive sliding sports (luge, skeleton, bobsleigh) would take root in our sporting culture and flourish.

The opportunity to host 2 Winter Olympic Games (1988, 2010) cemented Canadians' commitment to growing the sliding sports, and parlaying their experience and love of sliding into podium-worthy performances on the world stage. Luge, skeleton, and bobsleigh have been slowly garnering more participants in Canada ever since, and sport organizations have been capitalizing on successes, actively strategizing talent identification and recruitment, and developing training programs and venues to mold natural sliders into solid competitors.

The future growth and sustainment of Canadian sliding sports is an important consideration, and will depend on a strong commitment to developing sliders in a systematic, engaging way over the long-term. Because sliding sports tend to be late-specialization sports, it would be advantageous to create early opportunities to harness the passion for speed and sliding in would-be athletes and apply it to sports and recreational activities that further cultivate the skills and physical attributes necessary for successful sliding. Deliberate effort must then be made to entice athletes to direct their interest and athleticism to sliding sports when the timing is appropriate. Once recruitment to sliding sports happens, having the resources in place to leverage the skills and abilities of the entry-level athletes, and maximize their potentials is crucial for future success and sustainability.

### ***Introducing Long-term Athlete Development (LTAD):***

The LTAD model provides Canadian sliding sports with a much needed, intelligent framework and resources to systematically guide the development of sliders from a young age to international competition, and life-long healthy lifestyles.

The concept of LTAD was born out of gaps in a Canadian sporting system built somewhat reactively over time – a system that, by design, has had to focus more on the short-term needs of sports (e.g. competing and winning) versus the long-term health of sport and lifestyle programming. Thanks to the extensive research and collaboration of Canadian Sport Centres’ LTAD expert group, and the agreement by the major sport funding partners in Canada to better align and integrate their financial and human resources into a comprehensive Canadian Sport Policy, the opportunity to create clear building blocks for sport development has arrived. LTAD is now one of the key structural elements in a new Canadian sport system.

Canadian sports, like the sliding sports, are now adopting the concepts of LTAD to develop sport-specific LTAD frameworks, so as to provide clear, consistent developmental pathways for their respective athlete groups. LTAD is about ensuring that athletes get optimal training, competition, and recovery throughout their careers so they may reach their athletic potentials, and enjoy participation in sliding and other physical activities throughout their lives. 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 accelerated adaptation to training. LTAD also takes into account the physical, mental, emotional, and cognitive development of all participants.

Bobsleigh Canada Skeleton and Luge Canada are pleased to present the *Canadian Sliding Sports Long-Term Athlete Development (LTAD) Framework*. This LTAD framework is meant to provide parents, coaches and athletes with a comprehensive resource for guiding and shaping the successful development of sliders at any stage. Specifically, this document will provide a basis of understanding of the sliding sports, the core principles of LTAD and their relevance to sliding sport development, and guidelines for implementing the key elements of the developmental pathways for luge, skeleton and bobsleigh.

## *Defining the Sliding Sports*

### ***Sliding Sport History:***

The sports of luge, skeleton and bobsleigh all originated in a similar fashion in the health-spa town of St. Moritz, Switzerland in the mid-to-late 19th century. A hotel entrepreneur successfully sold the idea of winter resorting, of which winter activities were a part. His more adventurous English guests began adapting delivery boys' sleds for recreation, which soon created mayhem in the town, as sliders frequently collided with pedestrians while speeding down lanes and alleys. The results: hotel guests began devising steering mechanisms and refining the sleds, birthing luge, skeleton and bobsleds/bobsleighs (which were upsized, passenger-carrying luge/skeleton sleds with steering mechanisms), and eventually, the hotelier built the first track in St. Moritz to contain and manage the sledding chaos in the village (still used in World Cup competition today...). Thereafter, luge, skeleton and bobsleigh slowly morphed into the internationally popular, highly competitive, and physically and mentally demanding sports we know today, with Canadians sliding to success in competition in more recent decades.

### ***Luge:***

The sport of luge involves 1 or 2 lugers sliding supine (face up) and feet first on a gravity-powered sled (1 or 2-person 'luge') down a naturally iced existing mountain, hill or road ('natural luge' and street luge), or an artificially iced, specially constructed banked track ('Olympic luge').

Olympic luge is a more competitively-evolved sport consisting of three disciplines: men singles, women singles, doubles and team relay events. Success in Olympic luge is strongly defined by the start. The luge start is critical, and is the only part of the run where the athlete has control over the acceleration of the luge sled. Using the start handles on the side of the track, the slider/luger rocks the sled back and forth to begin the race. After releasing the start handles, he/she will gain the last bit of acceleration by paddling the ice with spiked gloves. The doubles start is essentially the same, with the top racer belted to the sled with a strap at the hips. With both lugers in sitting position at the start ramp, the top rider grips the start handles while the bottom rider holds on to the double straps attached to his/her partner's arms. Rocking back and forth in unison, they sling-shot out of the start and onto the course. After the start, an aerodynamic sliding position is quickly assumed, with racers reaching up to 150km per hour while steering their sleds with subtle movements of the shoulders, legs and hands.



In World Cup, World Championships and other international competitions, two heats are held in each event. At the Olympics, four heats are held in singles and two in doubles. The racer or team with the lowest combined time is the winner.

Opportunities to get involved in the sport of luge are available, with recruitment camps in Canada being offered by Provincial Sport Organizations and clubs to athletes 8-14 years old with an interest in cultivating sliding skills and developing the physical attributes to do so.

### ***Skeleton:***

The sport of skeleton requires an athlete to slide prone (face down) and head first down a twisting, banked ice track (as per Olympic luge and bobsleigh; the same track is used) on a gravity-powered sled.

The race start (the first 50 meters of the race) is the most critical component of a skeleton race. Sliders are looking for an early advantage as they push their sleds from a standing start over the initial portion of the track. Once loaded on the sled, steering is accomplished by careful head, shoulder, core and leg manipulations of the sled, which can reach speeds of 140km/hr.

In skeleton, there are separate racing disciplines for men and women. In World Cup competitions, two heats are held over one day in each event. At the Olympics and World Championships (held annually except in the Olympic year), four heats are held over two days. The athlete with the lowest combined time in all events is the winner. There are also Intercontinental Cup, America Cup and Europa Cup race series, which are National development circuits for the mid-early to mid-career sliders (often cross-sport athletes). The development of early sliders (11/12+ years old) is typically facilitated by Provincial Sport Organizations or sliding clubs, until which time athletes progress to a Cup series level and are supported by the National Sport Organization.

### ***Bobsleigh:***

Bobsleigh (or 'bobsled') is a sport requiring teams of 2 or 4 make timed runs down narrow, twisting, banked ice tracks in a gravity-powered sled. Bobsleigh teams consist of a brakeman and a pilot in the two-man/women event, and a brakeman, two crewmen and a pilot in the four-man event.

The bobsleigh start, as with luge and skeleton, is considered the most critical component of the race. Teams look to gain a significant advantage over opponents over

the 50 meter start distance, as they push the sled explosively off the start line from a standing position and load into the sled. Once the crew has loaded, it is the driver's job to steer the sled (with steering mechanisms attached to the front runners of the sled) through twisting, high-speed turns and straight-aways where top speeds can reach over 150 km/h.

In World Cup competitions, two heats are held over one day in each event. At the Olympics and World Championships (held annually, except in the Olympic year), four heats are held over two days in both the two-man/women and four-man events. The crew with the lowest combined time in all events is the winner. There are also Europa Cup and America's Cup race series, which are development level circuits for the mid-early and mid-career teams (typically 16+ years old recruited from other sports – track, football, etc.). The development of new/early sliders is typically facilitated by Provincial Sport Organizations or sliding clubs, until which time athletes progress to a Cup series level.

## ***Critical Elements of Sliding Success***

Sliding has evolved substantially over the years, with significant advances being made in equipment, tracks, and physical standards of performance. The competitive bar has been set high across all sliding sport disciplines, necessitating the identification and strategic development and management of several critical elements of sliding proficiency to be successful on the world stage.

Luge, skeleton and bobsleigh share common traits, with all requiring a high degree of mental and physical fitness to be successful, especially at upper levels of the sports. There is also a degree of 'art' involved in being a slider that speaks to the unique connection sliders have with their sleds and the 'feel' they develop and rely on.

### ***Decision-Making: Mind and Body***

Because of the sheer speed involved in all sliding sports, athletes must not be risk-averse, and enjoy the thrill of speed. However, sliders must also have exceptional decision-making skills and mental and physical acuity (kinesthetic awareness) to be able to make the split-second decisions and multiple subtle physical adjustments required to properly navigate the twists and turns of the track at high rates of speed, and carefully adjust/correct the movement of the sled (over-adjusting or under-adjusting can have very adverse consequences...). All sliders talk about the 'feel' they develop that

describes the use of these attributes when sliding, and helps them find and maintain position of the sled on the 'sweet spot' of the track.

For bobsleigh drivers, the additional experience and prowess of driving skills is advantageous. Pilots must hone keen navigation skills to maneuver the sled down the narrow, twisting tracks at high rates of speed, have exceptional reaction skills to respond to multiple impulses, and fine-motor skills to vigilantly handle the steering ropes.

***Resilience:***

The act of sliding also takes its physical toll on the body. Sliders experience 5Gs (G-forces or 'gravitational' forces) of force when sliding at high rates of speed through tight turns of the track, and yet must maintain aerodynamic positions and body control despite those forces. Sliders also get physically bumped around inside the sled (bobsleigh), and experience crashes as part of learning and racing, while wearing minimal protective equipment (thin race suits, gloves, shoes/track spikes and motorcycle-like helmets and visors). As such, all sliders must be physically strong and resilient in every area of their bodies (necks, upper body/torso, core, legs...) to withstand the natural consequences of sliding.

***Mastery of the Start:***

With luge, skeleton and bobsleigh, the start of each race is the difference-maker in results. As a rule of thumb, a tenth of a second advantage in the start will multiply to a lead of three-tenths of a second at the finish, so sliders must devote a considerable amount of time training to master the start.

***Physical Conditioning:***

Luge athletes must have a high degree of upper body, core and upper thigh strength to rock the luge sled in the start, and coordinated explosive power to propel the sled off of the start line and accelerate. Lugers then paddle rapidly with their hands along the track to gain momentum before assuming their aerodynamic sliding positions, and this requires additional upper body strength and power.

For skeleton and bobsleigh, in particular, speed and power are essential ingredients with running starts, with balanced lower-body strength and core strength as a key precursors to speed and power, as well as upper body strength to facilitate maintenance of an optimal sprinting position and help accelerate the body forward. Position-specific strength is also required to push the sleds. Skeleton athletes are required to run bent

over while pushing their heavy sleds (33kg for males, 29kg for females) before loading, which requires a considerable amount of core strength and endurance to maintain that position, without compromising lower body running mechanics or speed and power. Upper body strength and power is also required to push the sled with 1 arm, while alternately helping to propel the body forward with the opposite free arm. In addition to lower body strength, speed and explosive power, upper body and core strength are very important attributes for bobsleigh, as well as sheer physical size, to allow the athletes to be able to push, propel and control a heavy sled off the start line (sleds are a minimum of 170kg).

***Athleticism:***

For skeleton and bobsleigh, notably, a certain degree of athleticism and coordination is required to physically load onto the sled at a high rate of speed, and considerable practice is needed to master the nuances of doing so.

***Sled Maintenance:***

All sliders must also take an interest in and make a strong commitment to maintaining their sleds. Sliding athletes are required to understand their equipment, and diligently do what is required to keep it in pristine condition and improve upon it to stay competition-ready.

***Vigilant Planning:***

Importantly, athletes must commit to planning to be successful. Training and recovery programs have to be carefully planned and timed (periodized) to optimize the physical and mental attributes necessary to perform successfully during key competitive windows each year, each quadrennial cycle (as per the Olympics), and throughout the career of an athlete, and athletes must be willing to adhere to and execute these plans as crafted to reach their respective potentials. This takes discipline and dedication.

***Responsibility and Maturity:***

Sliding athletes, as with all athletes, must be willing to reflect on their successes and failures, accept criticism, be accountable for their performances, and eager to do what is necessary to adjust their paths to achieve their athletic goals. Strong, highly-informed support systems are essential, but the responsibility for performance success ultimately rests with the athletes themselves.

## ***Why Do the Sliding Sports Need LTAD?***

In short, to build and sustain better Canadian sliders... The LTAD framework provides us with intelligent guidelines based on scientific research to direct when and how we train athletes to become strong sliders capable of achieving and repeating podium performances. With the unique physical, mental and technical demands of each sliding sport, and the typical timing of entry into sliding sports, understanding how to capitalize on key developmental windows, where possible, and help provide would-be sliders with the physical and mental tools they require for success and health over the long-term would be incredibly advantageous.

Among many things, creating an LTAD framework for sliding sports will:

- Delineate a clear pathway of development of the critical elements of success for all sliding sports.
- Provide a comprehensive guiding framework for parents and coaches to create and manage realistic expectations for training outcomes, given the developmental ages and athletic experiences of entry-level sliders, and individualize and optimize the training environment for their athletes to be successful at any developmental and competitive stage.
- Identify and capitalize on TID (talent identification), cross-training, and cross-sport opportunities to improve the scope and development of sliding sport athletes.
- Improve communication and collaboration between sliding sports, so as to benefit from shared experiences and resources in each discipline, and strengthen the foundation of sliding sports training and development.
- Improve communication and resources for parents and coaches working with clubs.
- Provide a resource to assist with communication and programming for training and competition venues.
- Improve exposure of sliding sports to grow participation.
- Contribute to the alignment of other LTAD sports in Canada for the betterment of all Canadian sports.

## ***The LTAD Framework***

The core LTAD framework developed by Canadian Sport Centres' expert group suggests that an athlete will progress through 7 key developmental stages on his/her way to elite-level performance. Although chronological age ranges are referenced in the

framework, developmental age is the key factor in recognizing when and how certain physiological, mental and emotional attributes can be optimally developed, how to plan recovery, and align expectations for competition and performance based on what is realistic.

These stages are as follows (and will be described in greater detail as they pertain to sliding sports later in the document):

- **Active Start:** 0 to 6 years
- **FUNDamentals:** 6 to 9 years (boys), 6 to 8 years (girls)
- **Learn to Train:** 9 to 12 years (boys), 8 to 11 years (girls)
- **Train to Train:** 12 to 16 years (boys), 11 to 15 years (girls)
- **Train to Compete:** 16 to 23 years (boys), 15 to 21 years (girls)
- **Train to Win:** 18+ years (boys), 19+ years (girls)
- **Active for Life:** any age

## *The 10 Key Factors Influencing LTAD*

The following factors are the research principals and tools upon which the core LTAD framework is built, and provide valuable insight into how to craft and implement a sport-specific framework for successfully developing and sustaining a healthy slider.

### 1

#### ***The Rule of 10:***

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

This 10-year factor is supported by ***The Path to Excellence***, which provides a comprehensive view of the development of US 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 12-13 year period of talent development from when they were first introduced to their sports to when they first made an Olympic team.
- Olympic medalists were younger -1.3 to 3.6 years -during the first 5 stages of development than non-medalists, suggesting that medalists were receiving motor skill development and training at an earlier age. However, it is noted that caution must be taken not to fall into the trap of early specialization in late-specialization sports.





Through an analysis of the international performers in sliding sports, it was found that **run volume** (the number of runs taken on a track in training and competition) in conjunction the 10-year rule can be used to identify an ideal starting age/talent identification (TID) point, as well as the optimal age to achieve elite performances in all of the sliding disciplines.

## 2

### ***The FUNdamentals:***

- FUNdamental movement skills are critical in the development of the slider as an athlete.
- FUNdamental movement skills + FUNdamental sports skills = ‘physical literacy’.
- ‘Physical literacy’ should be developed before the onset of the adolescent growth spurt.

Programming opportunities for the development of physical literacy in sliding sports should be sought for natural and Olympic luge based on the possible age of entry of athletes into these sports. Training programs run by luge organizations (natural and Olympic) should incorporate both FUNdamental movement skills and FUNdamental sport skills. Consideration of the holistic development of these athletes will ensure they have the proper athletic skills to perform competently as sliders, as well as enhance their participation in other sports – elite-level sports or ‘active-for-life’ pursuits. These basic physical literacy programs are less relevant to skeleton and bobsleigh given the chronological age and physical maturation of entry-level athletes, but nonetheless an important/foundational part of athletic development.

## 3

### ***Specialization:***

Very few sports are early-specialization sports (gymnastics, diving and figure skating are exceptions), and it is generally recommended that specialization should not occur until the 12-15 years of age after physical literacy is developed through a variety of athletic



and recreational pursuits. Specialization before the age of 10 in late-specialization sports can contribute 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.

For the most part, Canadian sliding sports fall into the late-specialization sport category. Therefore special consideration should be taken to ensure training and competitive programs for young sliders participating in natural and Olympic Luge offer a wide variety of physical activities that focus on general athleticism and fun. These programming considerations are less relevant to skeleton based on the typical age of entry (minimum 11/12+ years, but typically later) and bobsleigh. Athletes that choose to participate in bobsleigh, in particular, are typically funneled to this sport via the other sliding disciplines, or come from sports that develop many of the foundational attributes to perform effectively as bobsleigh athletes (e.g. football, track and field etc.).

## 4

### ***Developmental Age:***

The terms “growth” and “maturation” are often used together and sometimes synonymously. However, each reference specific biological activities within the body.

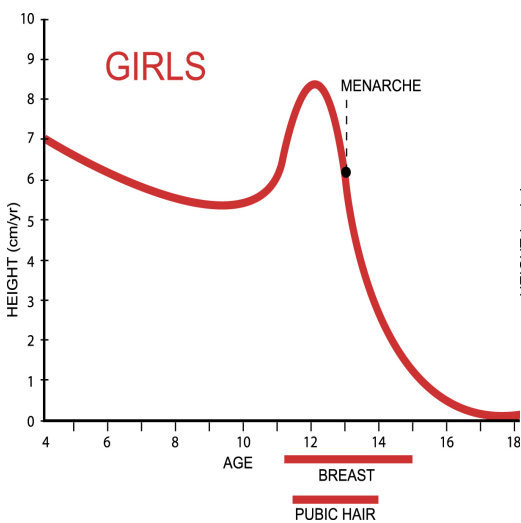
*Growth* refers to observable step- by step changes in quantity and measurable changes in body size, such as height, weight, and fat percentage. *Maturation* refers to qualitative system changes (both structural and functional) in the body's progression toward maturity, such as the change of cartilage and 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.

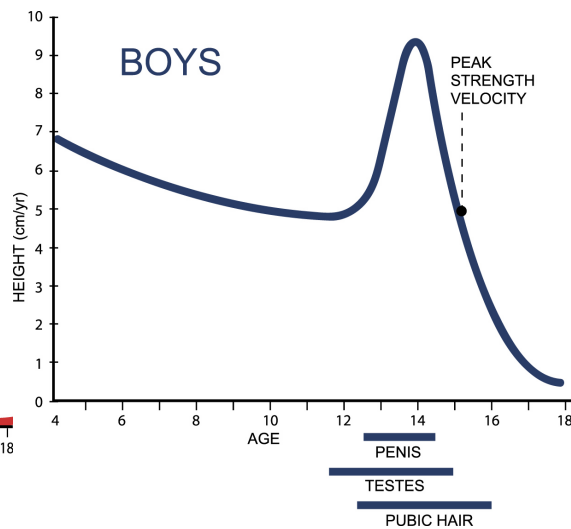
*Chronological age* refers to the number of years and days elapsed since birth. Children of the same chronological age can differ by several years in their level of biological maturation.

*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.

LTAD requires the identification of early, average, and late-maturing athletes in order to facilitate the design of appropriate training and competition programs relative 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.



**Figure 2—Maturity Events in Girls**  
(Modified after Ross et al. 1977)



**Figure 3—Maturity Events in Boys**

*Peak Height Velocity (PHV)* (or the maximum rate of growth during the adolescent growth spurt) is more pronounced in boys 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 male sliders. As with girls, the developmental sequence for a male slider 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-maturing peers will catch up when they experience their growth spurts.

***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 from 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 an athlete/slider 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.

*Sensitive Periods of Accelerated Adaptation to Training* refer to points in the development of a specific capacity when training has an optimal effect. All systems are always trainable, but capitalizing on these sensitive periods with training and practice will have a significant impact on lifelong athletic performance.

The windows of optimal trainability for females and males that take advantage of these sensitive periods are as follows:

- 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.

Based on the possible ages of entry into natural and Olympic (and in some instances, skeleton, if athletes start participating at 11/12 years), there are opportunities to take advantage of the windows of trainability with programming and competitive experiences. All other sliding sports cannot do so, as athletes typically enter skeleton and bobsleigh after these windows have passed. As noted, however, all systems are always trainable.

The sensitive periods of accelerated adaptation to training impact 5 different areas of physical development called “The 5 Ss”:

*1. Stamina (Endurance):*

The sensitive period of accelerated adaptation for training stamina begins when PHV is reached. Athletes need to increase their focus on aerobic capacity training as they enter PHV, and they should be progressively introduced to aerobic power training as their growth rate decelerates.

*2. Strength:*

The sensitive period for strength development for boys begins 12 to 18 months after PHV and for girls, begins with whichever of the following occurs first in the individual: menarche or the onset of Peak Weight Velocity (PWV). Some girls will experience PWV prior to menarche, while others will experience menarche prior to PWV.

*3. Speed:*

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

*4. Skill:*

The sensitive period of accelerated adaptation to skill training takes place between the ages of 9 and 12 for boys, and between the ages of 8 and 11 for girls.

*5. Suppleness (flexibility):*

The sensitive period for training suppleness in boys and girls occurs between the ages of 6 and 10 years old. Special attention should be paid to flexibility training during PHV and beyond to prevent injury to bones, muscles, ligaments and tendons as they grow.

## 6

### ***Physical, Mental, Cognitive, and Emotional Development:***

All training, competitive, and recovery programs should consider the mental, cognitive, and emotional development of each athlete. Sliding sports require a considerable amount of mental fortitude and keen decision-making skills, and therefore strategic development of these skills should accompany physical, technical and tactical training. A slider's cognitive ability should be considered when prescribing training programs (particularly with young luge and skeleton athletes), and careful attention paid to progressing cognitive skills according to developmental stage of the athlete.

For a complete overview of mental, cognitive, and emotional characteristics, their development and implications for coaching, refer to Appendices (sport-specific matrices).

***Periodization:***

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

Periodization sequences training components into weeks, days, and individual training sessions, and is dependent on priorities and the time available to bring about the desired training and competition improvement. Periodization organizes and manipulates 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 is far from being a single fixed methodology, and is in fact a highly flexible tool. When used appropriately with sound methodology and ongoing monitoring and evaluation, it is an essential component of optimal sports programming and slider development at all levels.

Within the context of LTAD, periodization takes into consideration growth, maturation, and trainability principles that are unique to the primary developmental stages (the first 2 decades of life), yet integrated with subsequent stages of athletic performance and life. LTAD is typically a 5 to 10 year process for optimizing physical, technical, tactical abilities (including decision-making) and mental preparation, as well as the supporting ancillary capacities. LTAD informs 2 major cycles for periodization planning:

- Quadrennial planning, which refers to the 4-year Olympic cycle for elite sliders.
- The annual plan, which is based on identified periods of 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. At present, there is very little information about periodization for children and adolescents, which impacts program design for very young sliders participating in natural and Olympic Luge, as well as skeleton.

### ***Calendar Planning for Competition:***

Consideration of calendar planning for competition is critical to development and success at every level of a slider's career. During earlier stages, developing physical capacities takes precedence over competition. Throughout the later stages of athlete development, the ability to compete proficiently becomes the focus of planning.

The following factors should be considered with calendar planning for training-to-competition ratios:

- 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 developing sliders as they progress through the LTAD stages.
- Over-competition and under-training at the Learn to Train and Train to Train stages for natural and Olympic luge and possibly at the earliest stages of skeleton participation could result in a lack of basic skills and fitness.
- Determining the appropriate level of competition is critical to the technical, tactical, and mental development of a slider at all stages. Specific strategies will need to be implemented to ensure sliders are exposed to the appropriate tracks for their stage of development. Suggested tracks and recommended training progression for each discipline can be found in the Appendix.
- The current system of competition is based on tradition, but it should be created to facilitate optimal training, performance and development of a slider depending upon his/her LTAD stage. The parameters of the track rating system become an important planning tool for LTAD programming.
- While international and national calendars are usually well integrated, a systematic review of club and provincial competition and training programs needs to be undertaken. Specifically, we need to look at the integration of:
  - Natural luge and Olympic luge.
  - Luge sliders and bobsleigh and skeleton driving.
  - Athletics CAN and bobsleigh and skeleton driving and pushing.
  - Collegiate and professional football and bobsleigh driving and pushing.
  - Rugby and bobsleigh driving and pushing.

***System Alignment and Integration:***

Athlete development and performance are central mandates of national, provincial/territorial and local sport organizations, and thus adopting and vigorously promoting the principles of LTAD is intuitive. These organizations must commit to collaborating, aligning and integrating in order to deliver programming that will significantly impact the quality of athletic development in Canada. Although coaches, teachers, and recreational professionals lead athlete training and physical activity programming at the ground level, they need to be supported by administrators, sport scientists, health, and government across multiple sectors.

There are several factors that can be improved upon as part of system alignment and integration with respect to sliding sports. System improvements could include:

- Track training time organization.
- Strategic planning at Calgary and Whistler venues.
- Yearly review of competition schedules, and strategic planning with respect to track proximity and return on investment.
- Improved talent identification (TID) and cross-training between all sliding sports.
- Relationship and interaction between:
  - Natural and Olympic luge.
  - Luge and bobsleigh.
  - Luge and skeleton.
  - Skeleton and bobsleigh.
  - Skeleton and Athletics CAN.
  - Bobsleigh and Athletics CAN.
  - Skeleton and collegiate and professional football and rugby.
  - Bobsleigh and collegiate and professional football and rugby.



### ***Continuous Improvement:***

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

Commitment to continuous improvement ensures that:

- LTAD constructs are evolving with new scientific and sport-specific innovations and observations, and subject to continuous research in all areas.
- 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 age groups.
- LTAD promotes ongoing education and sensitization of federal, provincial/territorial, and municipal governments, the mass media, sport and recreation administrators, coaches, sports scientists, parents, and educators about the interlocking relationship between physical education, school sport, community recreation, life-long physical activity, and high performance sport.

### ***The Sliding Sports LTAD Framework***

The LTAD framework for sliding sports describes the optimal developmental pathway for an athlete who starts sliding as a luge athlete at the age of 8 years and continues on to race successfully at the elite level either as a luge athlete, or as a skeleton athlete (11/12+ years) or bobsleigh athlete (16+ years). The early stages of development will be the same for all sliding athletes.

It should be noted that although some sliding athletes will initiate participation in luge at a young age, the majority of sliding athletes do not begin their participation in any of the sliding sports until much later. In fact, the sport of bobsleigh does not typically attract participants until athletes are in their 20s, have developed significant athletic prowess in other sports, and are looking for the unique training and competitive challenges bobsleigh affords. That said, the sliding LTAD framework speaks to what might be considered optimal, and delineates a potential athlete pathway that could be taken in the long-term pursuit of excellence at the elite levels of sliding competition or lifelong participation in sliding and other physical activities.

The following provides a general summary of the objectives and key outcomes of each stage of the sliding LTAD framework. More comprehensive information about the objectives of each developmental stage and key outcomes as they pertain to the respective sliding disciplines (luge, skeleton and bobsleigh) can be found in the sport-specific matrices in the Appendices.

# 1

## ***Active Start:***

**Age:** 0 to 6 years.

**Objectives:** To learn fundamental movement skills ('ABCs' – agility, balance and coordination) through unstructured play-based activity.

**Key Outcomes:** Fun and movement skills that will soon form the basis of fundamental sport skills (fundamental movement skills + fundamental sport skills = physical literacy).

Physical activity should be fun and a natural part of a child's daily life, not something required. Active play is the way young children should be physically active at this stage. Sliding does not have a specific function during the *Active Start* stage other than to provide an outlet for fun (sledding, tobogganing) and physical activity.

# 2

## ***FUNdamentals:***

**Age:** 6 to 8 years (females); 6 to 9 years (males).

**Objectives:** To continue to learn fundamental movement skills (ABCs) through unstructured play and a wide variety of more structured fun-based activities (e.g. land-based, water-based and snow and ice-based activities, like luge) where some instruction is provided to ensure more focussed attention is paid to developing movement skills and general fitness appropriately.

**Key Outcomes:** At the end of this stage, children will

- Be more competent in the fundamental movement skills.

- Be exposed to snow and ice-based sports (e.g. entry-level luge), and potentially have initiated skills development in luge (e.g. learning to start, learning to steer and body positioning).

*Note:* Hand and foot speed can be developed particularly well by boys and girls during this stage. If this sensitive period of accelerated adaptation to developing speed is missed, body speed may be significantly compromised later in life. Ideally, exposure to activities/sports that cultivate speed during this stage would be advantageous to sliding sports performance later in life. Strength, endurance, and flexibility are important to develop at this stage, but can be done through games etc.

### 3

#### ***Learn to Train:***

- *Luge: Learn to slide.*

**Age:** 8 to 11 years (females); 9 to 12 years (males).

**Objectives:** To learn fundamental sport skills through a wide variety of sport participation, including luge skills.

**Key Outcomes:** At the end of this stage, children will

- Be physically literate (competent in fundamental movement skills and overall sport skills).
- Develop some proficiency in luge-specific skills (e.g. paddling, steering, maintaining body position with speed, understanding track lines, entrances and exits etc.).

*Note:* The *Learn to Train* stage of the LTAD framework is the most important stage for the development of sport-specific skills, and represents a sensitive period of accelerated adaptation to skills training and fine motor control. It is also a time when children enjoy practicing their skills and seeing their own improvement, so they are captive learners. Attention paid to mastering sliding skills specific to luge is important to laying a strong skill foundation and proficiency after the growth spurt. Training represents 70% of the focus of sliding preparation (vs. competition), and sliders should still be participating in at least 2 to 3 different sports throughout the year to improve their general athleticism, even if a preference for sliding has been identified.

# 4

## ***Train to Train:***

- ***Luge:*** Build the engine.
- ***Skeleton:*** Learn to slide and build the engine.

**Age:** 11 to 15 years (females); 12 to 16 years (males) (dependent on the onset of PHV; this stage is defined by the start and completion of the adolescent growth spurt).

### **Objectives:**

- To build aerobic endurance.
- To build speed and strength.
- To improve flexibility/suppleness.
- To consolidate and refine sport-specific skills for luge (e.g. paddling and 'normal' starts, error detection and correction etc.).
- To introduce sliding skills to early-entry skeleton athletes.
- To identify potential talent in early skeleton athletes and recruit to competitive streams.

**Key Outcomes:** At the end of this stage, sliding athletes will:

- Develop a strong base of aerobic fitness.
- Develop strength and speed (anaerobic alactic energy system).
- Improve flexibility/suppleness.
- Improve luge-specific sport skills and competitive profile.
- Understand and apply skeleton-specific skills (e.g. push technique, loading, body position, steering etc.).

*Note:* During *Train to Train*, athletes are developing at a significant rate, and programming should be carefully designed to account for rapid growth and the advantages and disadvantages it presents to athletes. Luge athletes and skeleton (early entry athletes (11/12+ years)) should be monitored constantly to determine how their growth is impacting their training and performance and vice versa, and athletes should be made aware of possible natural impediments to performance so as not to become discouraged. PHV is an important marker for determining when certain physical attributes can be optimally developed.

The *Train to Train* stage can make or break an athlete/young slider. Although athletes may exhibit special talent, play to win, and do their best, they still need to allocate more

time to training skills and physical capacities than competing in formal settings. This is especially important for skeleton athletes, who, despite a potential sliding upbringing in the sport of luge, are just learning skeleton-specific skills and require focused time devoted to mastering the nuances of this sport. This stage is a critical conditioning stage, and to maximize long-term potential, winning should remain a secondary emphasis regardless of a given athlete's competitive aptitude. Athletes should be focussing on sliding and at least 1 other sport at this stage to maximize athletic potential.

## 5

### **Train to Compete:**

- **Luge:** Learn to compete (*Train to Compete 1 (T2C1)*). Optimize the engine and luge-specific skills and fitness (*T2C1 and Train to Compete 2 (T2C2)*).
- **Skeleton:** Build and/or optimize the engine and skeleton-specific skills (*T2C1*). Optimize the engine and develop sliding speed for competition (*T2C2*).
- **Bobsleigh:** Learn to slide, build/optimize the engine and bobsleigh-specific skills and fitness, develop sliding speed for competition, and consistency of performance.

**Age:** 15-21 years (females); 16 to 23 years (males).

- Luge:
  - T2C1: 15 to 17+/- years (females); 16 to 18+/- years (males).
  - T2C2: 17 to 21+/- years (females); 18 to 21+/- years (males).
- Skeleton:
  - T2C1: 15 to 18 years (females); 16 to 18 years (males).
  - T2C2: 18 to 21+ years (females); 18 to 23+ years (males).
- Bobsleigh:
  - T2C1: 15 to 18 years (females); 16 to 18 years (males) (early entry bobsleigh athletes).
  - T2C2: 18 to 21+ years (females); 18 to 23+ years (males) (mid-early entry bobsleigh athletes).

### **Objectives:**

- To solidify physical capacities needed for competition and elite-level performance (strength, speed, agility, suppleness/flexibility; sport and individualized physical fitness for competition and introduction to physical preparation to peak).

- To refine and solidify sport-specific skills for luge (e.g. starts, steering, error prevention, decision-making).
- To consolidate and refine sport-specific skills for skeleton (e.g. ‘normal’ push-technique and starts, sprinting technique, steering, consistency in gliding, error detection and correction etc., decision-making).
- To potentially learn sport-specific sliding skills for bobsleigh (for a small subset of early/mid-early entry athletes), while building/optimizing the engine and sport-specific skills (e.g. starts, sprinting technique, push-technique, loading, potentially driving in later stages, error detection and correction, decision-making etc.).

**Key Outcomes:** At the end of this stage, sliding athletes will:

- Develop strong foundations of physical capacities necessary for competition and elite-level performance.
- Solidify luge-specific skills necessary for elite competition.
- Improve skeleton-specific sport skills and competitive profile.
- Understand and apply bobsleigh-specific skills (e.g. push technique, loading, body position) and improve those skills and develop and improve a competitive profile.

*Note: See sport-specific matrices for more information regarding the specific objectives and outcomes related to T2C1 and T2C2 for luge, skeleton and bobsleigh.*

*Note:* For the purposes of the sliding sports LTAD framework and recommending what is optimal, it is assumed that in addition to having experience in a wide variety of sports, a sliding athlete will have an upbringing in the sport of luge prior to engaging in skeleton or bobsleigh. If they do not, athletic and competitive experience are likely and expected precursors to sliding sports participation, and the goals of this stage are widely applicable. *Train to Compete* is a critical stage for maximizing athletes’/sliders’ physical, mental, emotional, technical and tactical capacities necessary for competitive experiences, regardless of whether they are new to a sliding sport like skeleton. It also teaches athletes to handle all of the somewhat challenging nuances of the competitive experience (e.g. travel, weather, spectators, media, difficult opponents). As much as possible, training should simulate a variety of high-level competitive experiences to allow sliders to practice their skills in pressured conditions. This stage separates the recreational/community athlete/slider from the elite, and commands that the athlete commit full-time to training and competing for luge or skeleton (and bobsleigh, although entry into this sport is typically not at this stage developmentally). The *Train to Compete* stage of an athlete’s development entails year-round high-intensity, periodized

training for peak performance and a strong commitment to winning in a singular sliding sport, and competitions should be carefully selected to maximize the individual slider's competitive development.

## 6

### **Train to Win:**

- **Luge:** Learn to win (Train to Win 1 (T2W1)). Maximize the engine and luge-specific skills and fitness (T2W1 and Train to Win 2 (T2C2)).
- **Skeleton:** Maximize the engine and consistency of performance on all tracks to win (T2W1 and T2W2).
- **Bobsleigh:** Learn to slide, build/optimize/maximize the engine and bobsleigh-specific skills and fitness, sliding speed for competition, and consistency of performance (T2W1 and T2W2).

**Age:** 18+ years (females); 19+ years (males).

- Luge:
  - T2W1: 21 to 23 years (females and males).
  - T2W2: 23+ years (females and males).
- Skeleton:
  - T2W1: 19 to 24+ years (females and males).
  - T2W2: 25+ years (females and males).
- Bobsleigh:
  - T2W1: 19 to 24+ years (females and males).
  - T2W2: 25+ years (females and males).

### **Objectives:**

- To prepare all athletes/sliders to win consistently on the world stage. Medals and podium performances are now the key focus for each slider.
- To maintain the highest level of physical, mental, emotional, cognitive, technical and tactical preparedness required for winning performances.
- To optimize sport-specific skills for luge (e.g. starts, steering, error prevention, decision-making).
- To optimize sport-specific skills for skeleton (e.g. push-technique and starts, sprinting technique, steering, consistency in gliding, error detection and correction etc., decision-making).

- To optimize sport-specific skills for bobsleigh for early/mid-early entry athletes (e.g. starts, sprinting technique, push-technique, loading, driving, error detection and correction, decision-making etc.).
- To successfully transfer athletic and competitive skills and physical, mental, emotional and cognitive preparedness from other highly competitive sporting experiences (e.g. luge, skeleton, football, field hockey, hockey, track and field) to the sport of bobsleigh, and maximize/optimize those attributes as they pertain to bobsleigh (e.g. starts, sprinting technique, push-technique, loading, driving in later stages, error detection and correction, decision-making etc.).

**Key Outcomes:** At the end of this stage, sliding athletes will:

- Produce medals by winning World Cup and Olympic Competitions.
- Will consistently compete at the highest level of competition by repeating podium performances for more than 1 quadrennial cycle.

*Note: See sport-specific matrices for more information regarding the specific objectives and outcomes related to T2W1 and T2W2 for luge, skeleton and bobsleigh.*

*Note:* Once athletes reach the *Train to Win* stage, they have likely reached their genetic potentials, and optimization and maintenance of the attributes required for peak performance is a key goal – as well as delivering consistent winning performances. Athletes/sliders must learn to deliver winning performances on demand, and winning is the ultimate priority. Although bobsleigh athletes are typically entering the sport of bobsleigh at this stage (cross-sport recruitment), the emphasis is still on the delivery of podium performances, which behooves these athletes to rapidly refine and optimize the physical and mental attributes necessary for success in this sport. Sliders must be specifically trained to peak for major competitions utilizing the optimal periodization plans for their respective sports (single to triple periodization plans; see sport-specific matrices), and the training and competition ratio should be 25:75, with competition-specific training exercises comprising the competition percentage. Training should be high intensity and high volume, but frequent, preventative recovery breaks are essential to preventing physical and mental burn-out. Consideration should also be paid to creating transition plans for retirement.



# 7

## ***Active for Life:***

**Age:** This stage reflects a time when a slider may transition from competitive sport to recreational sport and/or activity, and this may occur at any age.

### **Objectives:**

- To continue to participate in sliding sports and/or a variety of sports and recreational activities.
- To continue to engage with the sliding community as an athlete or in another capacity (e.g. coaching).

**Key Outcomes:** During this stage, athletes will:

- Continue sliding at a competitive level (Masters level).
- Continue sliding in a recreational fashion (club system).
- Move from sliding to participation in another sport(s).
- Actively seek career-based or volunteer opportunities to stay involved with sliding sports as coaches, administrators etc..
- Continue to pursue physical activity/exercise for the purposes of fun, health and well-being, and overall quality of life.

*Note:* Regardless of the avenues pursued once a sliding athlete becomes *Active for Life*, it is important to focus on the health of the individual, first and foremost. Training-based activity or recreational activity should be geared to the fitness level and age of the individual (understanding age-related changes in response to training stimuli for flexibility, strength, speed and endurance development), and mindful of potential pre-existing 'wear and tear' on the body from a competitive lifestyle. Training and recovery programs design should encompass preventative health measures, and the volume and intensity of any exercise program adjusted to target optimal long-term health as a priority over shorter-term competitive performance goals.

It is also important to consider the mental, emotional and lifestyle adjustments an athlete/slider must make as he/she transitions to this stage from potentially a highly competitive sliding career. Having support systems and resources in place to accommodate what can often be a very challenging period in an athlete's life would be very advantageous.

## *Summary*

In short, LTAD is about developing athletes the right way – with a long-term, systematic approach that centers on what an athlete truly needs to be successful and healthy. The LTAD framework arms parents, coaches and athletes with educated guidelines to craft a solid foundation of physical literacy and fitness needed to propel an athlete/would-be slider to competitive success and/or lifelong health, well-being, and enjoyment of sport.

The widespread implementation of the sliding LTAD framework would unite sliding organizations (clubs, Provincial and National Sport Organizations) in employing a consistent programming philosophy and a design strategy created to capitalize on key development windows, where possible, and help athletes hone the physical, mental and tactical skills critical to sliding success. Positive communication and collaboration between sliding organizations around the LTAD framework would also allow for creative approaches to talent identification and recruitment to be generated, and potentially for the development of novel opportunities to engage young athletes in sliding-based or related activities earlier (e.g. sliding/tobogganing festivals, cart racing etc.).

Ultimately, through the application of the sliding LTAD framework, it is hoped that a strong team of Canadian sliders, capable of achieving and repeating podium-worthy performances, can be developed, and will raise the bar of performance on the world stage.

## *Sport Specific Glossary of Terms*

**Run volume** refers to the amount of runs on a track, which includes both training and competition runs. It has been identified that run volume is a key determining factor in sliding sports performance.

**Track Rating System** uses scaled scoring, which identifies and ranks the critical elements of sliding tracks around the world. The 'rating system' of the tracks is compared against the 'world's best' for the discipline.

**Track Rating Parameters** include:

- **Location and Country**
- **Overall:** This takes into account the single overall score to rate the tracks, which is done using a simple 3-level system.
- **Difficulty:** This refers to the technical competency required to negotiate the track not only safely, but relative to the world's best drivers/pilots.
- **Navigation:** Global rating of the appropriate 'line' of the track.
- **Quickness:** Difficulty of driving the track quickly.
- **Length:** Length of track in meters (male/female/discipline).
- **Corners:** Number of corners (male/female/discipline).
- **Speed:** Simple rating of relative speed of the track (slowest tracks vs. fastest tracks).
- **Impact:** Effect on the drivers/sliders and crew; a measure of the training/competitive 'cost'; useful for planning and assessing training/competitive load.
- **Race Frequency:** Rating as to how often Canada 'races' at the track.
- **Training Saturation:** Maximum number of runs per day (including multiple sessions) that could be attained with an aggressive training regime.
- **Proximity:** Practical closeness to other tracks.
- **Return On Investment (ROI):** The 'ability' of a facility to give Canadian sliders a good ROI on a specific track.
- **Start:** Importance of the start sequence/performance on a 'run'.
- **Equipment:** Importance of equipment and equipment setup on 'run' performance.

### Sliding Sports Events:

- Olympic Luge Singles (males and females (M & F))
- Olympic Luge Doubles (M & F)
- Natural Luge
- Skeleton (M & F)
- Bobsleigh 2-man (M & F)
- Bobsleigh 4-man (M)

### **Luge Sled Components:**

**Steels/Runners** refer to the two steel sled components (left and right) in contact with the ice.

**Pod/Sling Seat** refers to a sled component, which allows the athlete to lie in a prone or sliding position. The pod length is constructed to provide support from the athlete's knees to the athlete's shoulders. This supportive design is critical to performance because the transfer of the athlete's body movements through the pod enhances the sled's ability to turn and transition from straight-aways to banked corners.

**Kuffens** refer to two sled components (left and right) that are connected to the steels and bridges. The kuffens extend forward to the athlete's legs and allow the athlete to guide the direction of the sled.

**Bridges** refer to two sled components (front and back) that are constructed of metal. The front bridge is located under the athlete's upper hamstrings and the back bridge is located under the athlete's shoulders. These bridges are connected to both the kuffens and the pod. The role of the bridges is to ensure the sled can scissor or pivot. This motion is critical for the sled's ability to turn.

**Weight vest** refers to an item of the athlete's equipment, the purpose of which is to provide ballast that allows lighter athletes to compete equally with heavier athletes. This equality is determined through an acceptable formula developed by the FIL to ensure fair competition.

### **Skeleton Sled Components:**

**Frame** refers to the steel components that make up the basic structure of a skeleton sled. The frame includes transverse and longitudinal rails constructed together with accompanying runner blocks, saddle mounts, post guides, torsion bars and steering elements. Frame dimensions and construction are regulated as per the FIBT rules.

**Pan** refers to fiberglass or steel "half-shell" or "pod" which is fastened to the underside of the frame (between the frame and ice surface), and contributes to the aerodynamic properties of the skeleton sled. Pans can be either short or long depending on the needs of the athlete.

**Runners** refer to the steel rails which when fastened to the frame allow an athlete to travel down the track on ice. Runners have both smooth and grooved sections, which give the athlete the ability to control the sled direction while traveling down the track by applying friction to the runner and the ice.

**Saddle** refers to the two independent pieces of curved metal attached to individual baseplates and attached to the frame, and serves as the mounting point between the athlete and sled. An athlete will initiate the start with the sled in a bent over running position, and upon loading, lay in a headfirst prone position on the sled. A saddle is typically constructed to the dimensions of an athlete's chest, stomach, hips and arm length. The saddle, in conjunction with the athlete's body being in contact with the topside of the frame, allows the athlete to remain throughout a run in a position which maximizes an athlete's control over the runners and sled within the curves of a track.

**Weight** refers to ballast added to either a sled's frame or saddle. Total sled weight and combined athlete/sled weight is specified within the FIBT rules. Weight, while assisting with momentum down the track, has also been attributed to greater resistive forces upon an athlete during push phases of a skeleton run.

### **Bobsleigh Components:**

**Runners** refer to the four metal "blades" that are mounted to the bottom of the 2-man or 4-man sled. The front and back runners are parallel and attached by axles. The runners provide the sliding surface for the sled on the ice, and are also the mechanism with which the steering inputs from the driver are carried out. The runners have a rounded edge, which provide steering control only in the corners when the g-forces are high. Control in the straight-aways is minimal.

**Sled** refers to the 2-man and 4-man "vehicles" that the athletes travel down the track in during training and races. It consists of a metal frame encased in a fiberglass or carbon fiber cowling. The driving mechanism is attached to the front-runners and allows the pilot to steer the sled down the track.

**Weight bars** refer to metal bars that are bolted to the frame of the sled in order to achieve the minimum or maximum weight limit for competition.

**Driver/Pilot** refers to the athlete who sits at the front of the sled. He/she is the driver of the sled.

**Brakeman/crew** refers to the other members of the bobsleigh team, which would include 1 additional member for 2-man and 3 for 4-man. The primary duty of these athletes is to accelerate the sled at the start. The brakeman is also responsible for stopping the sled after it has crossed the finish line.

### **Federations:**

**FIL** refers to the "International Luge Federation" (Fédération Internationale de Luge de Course/ FIL), which governs both Olympic and natural Luge.

**FIBT** refers to the the Fédération internationale de bobsleigh et de tobogganing, which governs both the sports of bobsleigh and skeleton.

## ***Appendices***