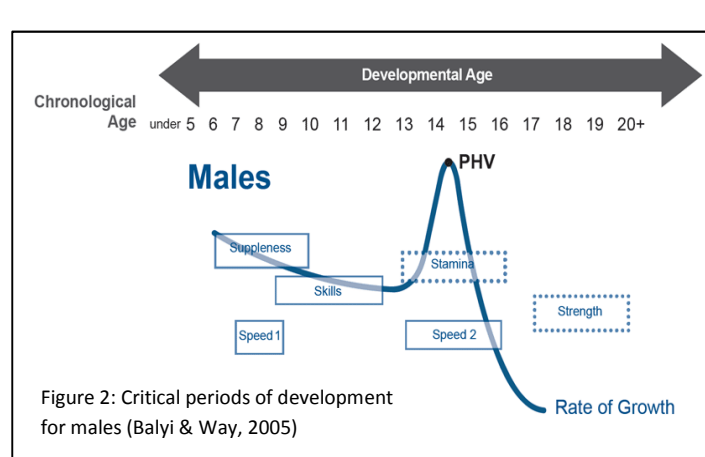
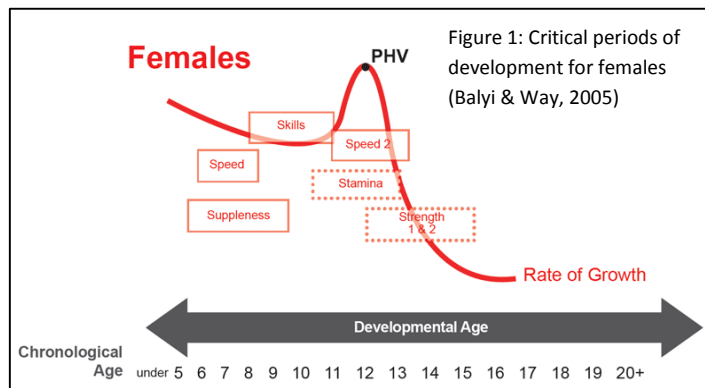


USSA Training Systems: Critical Periods for Optimal Development

The USSA Training Systems outline the progression of ski and snowboard athletes throughout their physiological development to lead them to their full potential in the long-term. Central to the training recommendations within are the concepts of "biological age" and "training age". As athletes reach age 9 or 10, their physiological development in relation to their same aged peers can start to differ substantially. The developmental phases referenced in the Training Systems are defined by their physiological growth, rather than their true age. The reason this is important is that as each child develops, they go through periods called "critical periods" where they are capable of making maximal improvements in certain skill areas. With a better understanding of how to take advantage of these critical periods, and taking into account the individual development phase of each athlete, coaches, parents, and athletes can substantially benefit in the long-term. If the right things aren't done during these critical periods, development will take a much longer time and will be much more difficult. Let's take a look at some of these critical areas and factors that need to be taken into account with athlete training.

Figures 1 and 2 illustrate the typical ages that children move through these critical periods (Balyi and Way, 2005). The red and blue lines indicate child's the rate of

growth. The fastest rate of growth is called peak height velocity (PHV). All children grow in this general pattern, but understand that the figures represent the averages. The curve may shift to the right or left depending on the individual, which can extend or shorten a given window for that athlete. Furthermore, coaches working with athletes in these ages will have children in different windows that are the same age. Understand that these periods are not the only time to focus on the specified domains, quite the contrary. These periods are when the athletes can make the most rapid gains, but in certain areas the training emphasis needs to be just as high before or after to maintain those gains



(suppleness through the puberty phase, for example). We'll cover more considerations for early and late developers in a later article.

Perhaps the most important critical period for skiers and snowboarders is the **motor skills development** period, which begins at around age eight and runs through phase 3 in the Training Systems (see Training Systems phases in the figure on page 2).

Figure 3: Typical ages for the USSA Training System developmental phases.

Foundation Stage		Pre & Post Puberty			World Class Performance Full Maturation
PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6
Biological Age Pre Puberty Age 2–6 years old Play Age 1–4 years in sport	Biological Age Pre Puberty Age 6–10 years old Training Age 1–4 years in sport	Biological Age Pre Puberty (Before Growth Spurt) Age Girls: 10–13: J4 (J5–J3) Boys: 11–14: J4 (J4–J3)	Biological Age Puberty (Growth Spurt) Age Girls: 11–14: J3 (J4–J3) Boys: 12–15: J3 (J4–J2)	Biological Age Post Puberty (After Growth Spurt) Age Girls: 12–16: J3 (J4–J2) Boys: 14–17: J2 (J3–J1)	Biological Age Full Maturation Age Female: 16+ J2–J1 Male: 17+ J1 Training Age

This is the time when it is essential for athletes to learn the fundamental movement patterns for their sport. Because skiing and snowboarding take place in widely varying environments, subject to snow conditions, weather, different terrain and courses, the basics that must be acquired are more diverse than most would think. During the motor skills period, children are particularly adept at taking similar skills from one sport and applying it to another, making cross-training a very effective development tool. The USSA encourages athletes to participate in multiple complementary sports to skiing and snowboarding during this period, and this participation should help keep them fresh and motivated and will mitigate overuse injuries from specializing in one discipline or training method too early. The best activities for athletes in this period are those that challenge agility, balance, coordination, and speed (quickness in short bursts and reaction time, not 80mph speed skiing). This type of conditioning is not emphasized enough in our school systems, and ski and snowboard athletes and programs need to address potential deficiencies here during this period.

The content of on-snow training during this period must be active and varied. Time should be spent on all-around basic skills, with an emphasis on proper technique and building progressively from an environment that the athlete can complete the task correctly, then adding challenge and variables once they are ready. A fun, game-oriented approach is most effective. Take advantage of the time on-snow by skiing or riding. Limit the amount of tech talk and standing around. By the end of this period, athletes should have mastered the basic fundamentals. Coaches need to be creative with how they teach these skills. It needs to be fun to keep the kids motivated and engaged, and it needs to be challenging to maximize the learning. The challenge should come from appropriate variety and skillful progressions with a steady emphasis on the proper movements and techniques. If these fundamentals aren't emphasized in this phase, or if poor fundamentals are learned, it will be extremely difficult for the athletes to adjust and correct later in their development and their long-term potential will be limited.

For endurance based sports such as cross-country and Nordic combined, the critical period for the development of **stamina** starting at the onset of the growth spurt is very important. Like the development of motor skills, the work a young athlete does during this period which stretches through puberty sets the foundation for the athlete's aerobic capacity. As far as an individual's long-term potential is concerned, it is difficult to make up a lack of stamina work during this period. For the other USSA sports, it is an important time to emphasize endurance training so that athletes will be able to sustain high performance through long training and competition days and to aid in recovery from high intensity sessions.

The critical period for maximum gains in **strength** is different for males and females. Females enter this critical period right after PHV. For males, this period doesn't begin until 12-18 months following PHV. Since females achieve PHV on average 1.7 years before males, and due to societal and social factors, this

period is often not taken advantage of by female athletes. As a result, we observe a higher rate of injury for females in their later teen years. Note that this strength window does not mean that athletes of this age should immediately start performing low repetition maximal work, but rather they are physiologically ready to increase load and will respond with muscle growth. Before this period, gains in strength are primarily due to neuromuscular adaptation. Another important implication of this period is that athletes should be trained in the proper techniques for strength training prior to this window, so they will be prepared to take full advantage of the gains while lessening the chances of injury.

The **suppleness** critical period in phases 2 and 3 is the time where young athletes can make great gains in their flexibility. This is very important for the acrobatic sports, and is key for all the USSA sports to improve range of motion for future recovery skills and athleticism. The end of this critical period is not the end of flexibility work, it needs to continue beyond this window with the understanding that gains will slow or even decrease during the growth spurt and puberty, even with continued training.

The critical period for **speed** development has two parts. The initial speed window in phase 2 is ideal for development of quickness and reaction speed. Training should focus on short bursts (up to ten seconds). In the second speed window, during phase 4, muscular power begins to come into play and movement speed is emphasized through short sprints, jumping, and gymnastics type exercises. This period focuses on whole body movement through a full range of motion with an emphasis on quickness and coordination, realizing that coordination may be difficult for the athlete during the growth spurt.

A final important element to consider in training is the lack of development of the anaerobic system until after puberty. Anaerobic power is the primary system used for high intensity activities ranging from 15 seconds to two minutes, so it is of high importance for skiers and snowboarders. Athletes though puberty will have greater benefit working on developing their speed and endurance independently through very short and long duration training, than trying to make large gains in anaerobic power. Combined with the shorter attention and concentration span of younger athletes and the importance of proper fundamental skill development, short and focused drills and courses may be most productive for the majority of skills practice.

As each athlete develops at different rates, it is important that coaches consider each athlete individually, and plan a program that will maximize their development based on these critical periods. While in the short-term some athletes may seem to be getting ahead, or falling behind, with this approach, in the long run, all athletes reach their full potential.

Continue to check the USSA Training Systems webpage at <http://trainingsystem.ussa.org> for more information about long-term athlete development.