IIHF COACH DEVELOPMENT PROGRAM

LEVEL I

PHYSIOLOGY

FAIR PLAY
AND RESPECT

11. GROWTH AND DEVELOPMENT

FAIR PLAY
AND RESPECT

11. Growth and Development

Having a positive and effective relationship with your players is necessary to ensure that they receive the most out of their hockey participation. Understanding your players' levels of physical, mental, social, and emotional development, and designing guidelines to meet your athletes' developmental needs, will help to establish a satisfying relationship with your players.

Upon completion of this chapter, you will be better prepared to:

- *describe and understand the four main areas of development;*
  - *physical,*
  - *mental,*
  - *social,*
  - *emotional,*
- *recognize that there are differences in the levels of physical, mental, social and emotional development between and within players,*
- *identify the key characteristics of the four growth and development stages of athletes;*
  - *pre-adolescence,*
  - *early adolescence,*
  - *middle adolescence,*
  - *late adolescence,*
- *develop guidelines to meet the players' needs during the four developmental stages.*

11.1 Areas of Development

To understand the growth and development of a young hockey player it is helpful to understand the four main areas of development:

- Physical: height, strength, and weight
- Mental: thinking and understanding
- Social: interacting with others
- Emotional: feelings and attitudes

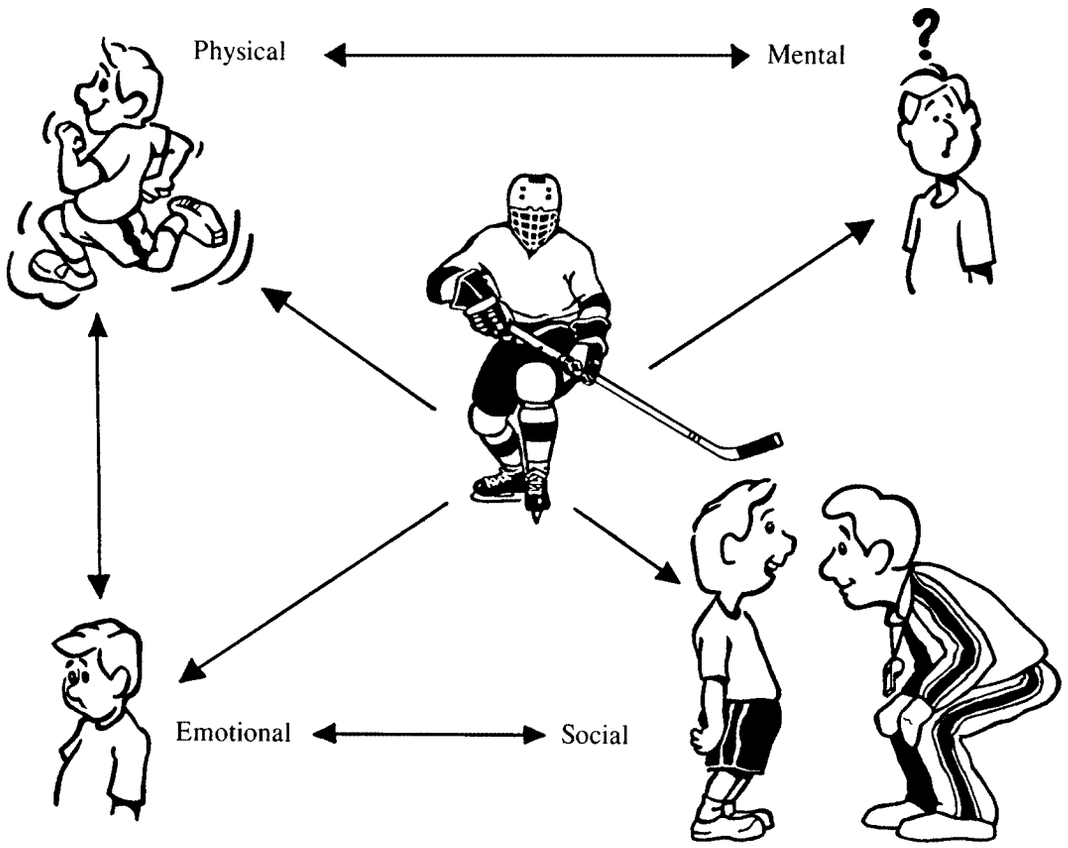


Figure 1: Schematic illustration of the interaction between the four main areas of development.

As is illustrated in Figure 1, the overall development of each player is influenced by a constant interaction between the four areas of development.

What is physical development?

Physical development describes the changes which take place in the physiological makeup of an individual. Physical development is measured by such factors as height, weight, body build, strength, endurance, flexibility, rate of physical maturation, motor skill coordination (eye-hand, eye-foot), physical health, and body composition.

What is mental development?

Mental development consists of memory, perception, language, information processing, and thinking abilities which influence decision-making and the understanding of the rules of play and team concepts.

What is social development?

Social development refers to the ability to interact effectively and get along with others. Appropriate social behaviour consists of being able to get along with teammates, coaches, and parents, as well as showing respect for team and league rules. In a team sport such as hockey, athletes must understand their roles on the team.

What is emotional development?

Emotional development is part of a person's personality development and it refers to the ability to express and control one's emotions. For example, before a big game it is important for players to control their level of anxiety or nervousness. Also, in frustrating situations, such as after an unintentional penalty or rough play by the opposition, it is important for players to keep their cool and display disciplined behaviour.

11.2 Differences in Development

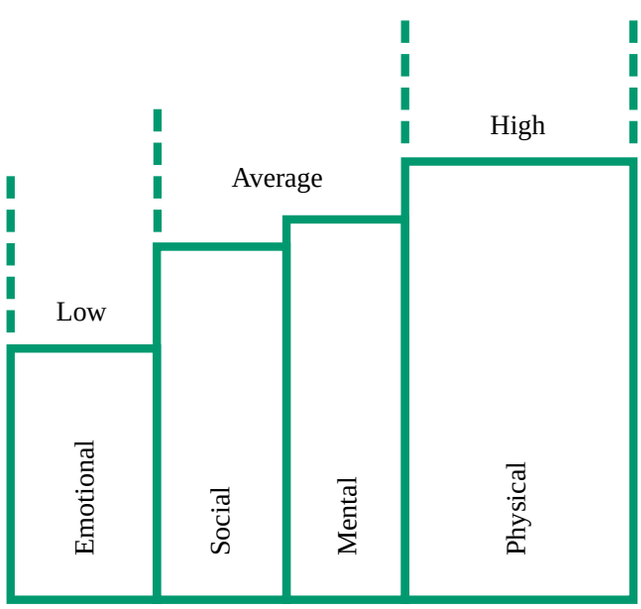
It is important to remember that even though the four main areas of development are highly interrelated, there may be different rates of development in each of these areas for each player.

As a result:

- There may be substantial differences **between** athletes in terms of the levels of their physical, mental, social, and emotional development.
- There may be differences **within** athletes in terms of the levels of their physical, mental, social, and emotional development.
- It may be useful for coaches to create developmental profiles for each player. Each athlete is unique and, therefore, each grows and matures at a different rate. The following two examples will highlight differences between and within players in terms of their stages of development in each area.

Example 1

Player A (Male)

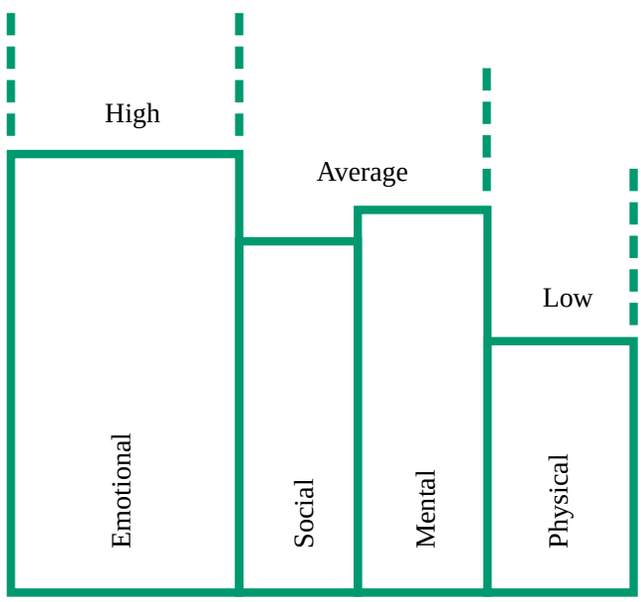


For this player, we can see that his level of physical development is more advanced than his levels of mental, social, and emotional development. The behavioral implications of this developmental profile may be the following:

- This athlete will be bigger and stronger than most of his teammates and he may possess excellent hockey skills.
- Due to the lag in the level of mental development, this athlete may tend to play as an individual without regard for the team strategy which the coach is trying to implement.
- Teammates may begin to reject this player because he is a “puck hog” and he may become a “loner” and his social development may suffer as a result.
- The lack of emotional maturity may cause this player to become easily frustrated when things do not go well and he may exhibit emotional outbursts, such as temper tantrums or arguments with teammates or coaches. During early adolescence, these tantrums may result from frustration and are typical of low emotional maturity.

Example 2

Player B (Female)



For this player, we can see that her level of physical development is not as far advanced as her levels of mental, social, and emotional development. The behavioral implications of such a developmental profile may be the following:

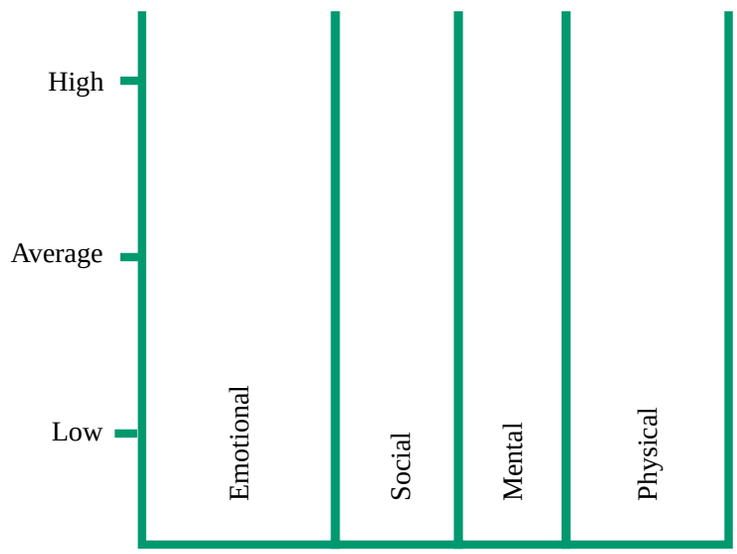
- This player will be smaller and physically weaker than many of her teammates; however, she may possess excellent timing and coordination.
- This athlete’s level of mental or intellectual development will enable her to grasp quickly the concepts of her team’s offensive and defensive strategies.
- The level of social development may lead to this player being very popular with her teammates.
- This athlete’s advanced level of emotional maturity will help her to control her emotions and thereby allow her to refrain from undesirable actions such as taking unnecessary retaliation penalties.

For the Coach

Think of one of your players. What is this athlete's level of development in the physical, mental, social, and emotional areas as compared to the other athletes on your team? What are the behavioral implications of the developmental profile you presented for your player?

Player: _____

Level of Development:



Behavioral Implications:

_____

_____

_____

_____

_____

_____

11.3 Stages of Growth and Development

The growth and development stages of athletes can be grouped into four categories:

- Pre-Adolescence (up to 11 years)
- Early Adolescence (11-13 years)
- Middle Adolescence (14-16 years)
- Late Adolescence (17-19 years)

By identifying and understanding the main characteristics of each of these developmental stages, you will be better able to meet the needs of your athletes.

Pre-Adolescence (Up to 11 years)

Key Features

- This period differs slightly between males and females as females tend to mature more quickly than males, thus reaching adolescence at an earlier age.
- Significant changes occur in body structure, perceptual motor learning skills, and character development.
- As pre-adolescence is the most formative period, coaches should pay special attention to the needs of the athletes in this category.

Early Adolescence (11-13 years)

Key Features

- There is a rapid growth spurt which occurs earlier for females than for males (see Figure 2).

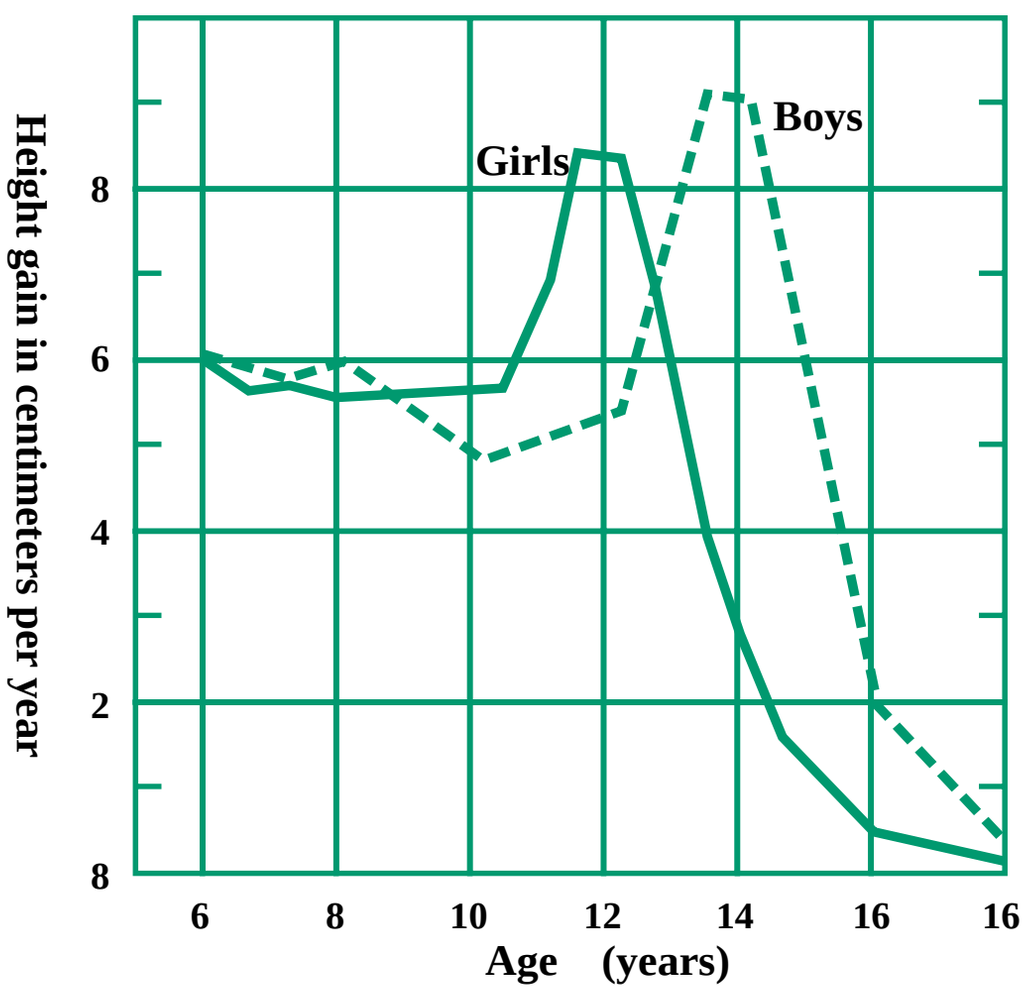


Figure 2: Velocity or Rate of Physical Growth
(Rate of growth refers to increments in height from year to year)

(From Tanner, J.M. *Growth at Adolescence*. Oxford: Blackwell Scientific Publications, 1962)

- The growth spurt may have a negative effect on the athlete's motor development, leading to awkwardness and a loss of fine motor skill coordination.

- The early adolescent may experience difficulties in learning new skills which require timing and coordination. For example, the player may have difficulty in giving a soft accurate pass, receiving a pass, or executing a snap pass.

- A rapid growth spurt may cause a lack of upper leg strength (quadriceps) which may negatively affect the skating stride if the player is unable to carry one's weight on the front leg in a flexed bent-knee position. To compensate for this, a player may skate in an upright position and exhibit a skating stride characterized by a high "heel kick" instead of a full leg extension.

Figure 3: Flexed Bent Knee Position

- Due to the rapid growth spurt, early adolescents become more aware of their physique and, through self-appraisal and appraisal received from others, they develop body images which in turn influence their self-images.

- Athletes develop the ability to reason and think in a logical manner. However, their attention is focused on the present with little thought of the future and long-term goals.

- Mood fluctuations and emotional outbursts, short in duration, are typical behaviours of early adolescents. Thus, tears may be seen after losing an important game, however, shortly after leaving the arena the athletes may be seen laughing and enjoying themselves, having apparently forgotten all about the loss.

- Frustration may be seen if the player has difficulty learning a new skill which teammates already have acquired (e.g., use of an outside edge for stopping). Fear of failure creates anxiety while the inability to perform a skill that others are performing causes frustration.

Coaching Implications

Empathize with your athletes. Put yourself in their place and viewing events from the players' point of view.

- Remember that your actions and comments have a significant influence on the psycho-social development of these young athletes.

- Use positive reinforcement and demonstrate appropriate behavior (e.g., good sportsmanship).
- Do not “fly off the handle” if a player displays an inappropriate behavior out of frustration. Try to understand that the athlete is passing through a stage of rapid physical and psychological development and certain outbursts due to frustration should be expected.
- Provide clear and meaningful explanations of your decisions as early adolescents are developing the ability to reason and may question certain requests.
- Goal-setting should be limited primarily to short-term goals (e.g., learning to stop or to turn).
- Players in the early adolescent period will respond well if they are given some responsibility and the opportunity to participate in goal-setting.

Middle Adolescence (14-16 years)

Key Features

- The rate of physical growth is much less dramatic than in early adolescence.
- Body systems are beginning to mature and the athletes are acquiring greater strength, endurance, and coordination.
- Thinking abilities are more sophisticated and the middle adolescent is able to think in both an abstract and an analytical manner.
- Middle adolescents become more willing to understand and even accept another individual’s point of view.
- Athletes become more aware of their physical potential and limitations.
- Players pass through a period of self-analysis which may lead to self-criticism and self-doubt. As a result, many 14,15 and 16 year olds drop out of hockey.
- This period is difficult for young athletes as the heightened awareness of the gap between “who they are” (real selves) and “who they would like to be” (ideal selves) may cause feelings of frustration and failure.
- Middle adolescence is also marked by the desire to experience new events in life (e.g., drugs, alcohol, cars, other sports, choosing close friends, and establishing meaningful relationships).
- Conflicts with authority figures, (e.g., coaches, referees, and parents) may occur during this period.
- Actions and comments of coaches, parents, and significant others can have a major influence on the types of attitudes, values, and dispositions athletes acquire with respect to these individuals and sport in general.

Coaching Implications

Since middle adolescents are passing through a period of self-analysis, you can be helpful by attentively listening to each player's concerns.

- Regular informal conversations with athletes should be used to help them identify realistic future goals and the means to attain them. In so doing, athletes become more aware of their "real" selves. This avoids problems which can arise due to an "ideal" self conceptualization.
- Be aware of the social influences on your athletes (e.g., drugs, and alcohol).
- Provide players with more detailed explanations and rationales when teaching skills, tactics, and systems.

Late Adolescence (17-19 years)

Key Features

- Except for the late maturers, there is limited physical growth.
- Strength and endurance will increase significantly for athletes who follow intensive training programs.
- The late adolescent spends a lot of time establishing a value system with norms, values, and beliefs that they intend to live by.
- The athlete's personality is now quite firmly developed and strong feelings of independence exist.
- In the players' attempts to fulfill their needs for independence, certain confrontations may occur with significant others (e.g., parents, coaches, and teachers).

Coaching Implications

- Recognize the importance of your athletes' needs for independence and personal responsibility.
- As some athletes become heavily involved in weight training programs to increase their strength, you should remind them of the importance of flexibility exercises. Also, reinforce the need for a thorough nutritional plan.
- Ask players to run part of the practice sessions, participate in establishing team policies, and, in general, experience various types of independent and responsible activities.
- Ensure that all players understand the significant roles they play on the team.
- For late adolescents you can become a respected counsellor who assists the athletes in establishing their value systems.
- Work together with your players to develop challenging goals which can be achieved through highly specialized training programs.

For the Coach

In what growth and development stage are your present athletes in? List what you consider to be the three most important characteristics of their development. Design specific guidelines to meet the needs of your players.

Stage of development: _____

Three most important characteristics:

_____

_____

_____

Specific guideline:

_____

_____

_____

_____

_____

_____

SUMMARY

To establish an effective coach-athlete relationship and to maximize satisfaction for each player, coaches must take into consideration the level of each athlete's physical, mental, social, and emotional development. Always remember these four important points:

- Each athlete is unique and, therefore, each will mature at a different rate.
- For each athlete the four areas of development will mature at different rates.
- Each player is an adolescent first and an athlete second.
- Design guidelines to meet the developmental needs of your players.

12. PHYSICAL PREPARATION

FAIR PLAY
AND RESPECT

12. Physical Preparation

Good coaches are always looking for that competitive “edge” which will be the positive difference in a close contest. It may very well be physical conditioning which provides it, especially when individual and team skills are relatively equal.

The coach who understands how the body responds to intense physical activity will undoubtedly be capable of preparing athletes to perform in any situation.

Upon completion of this chapter, you will be better prepared to:

- *recognize the human body as a cooperative of intricate systems;*
  - *Muscular system,*
  - *Cardiovascular system,*
  - *Energy system,*
- *understand the three energy systems and the energy demands of hockey,*
- *identify the role of the support systems in response to activity,*
- *recognize age considerations in planning for off-ice training.*

12.1 How the Body Works

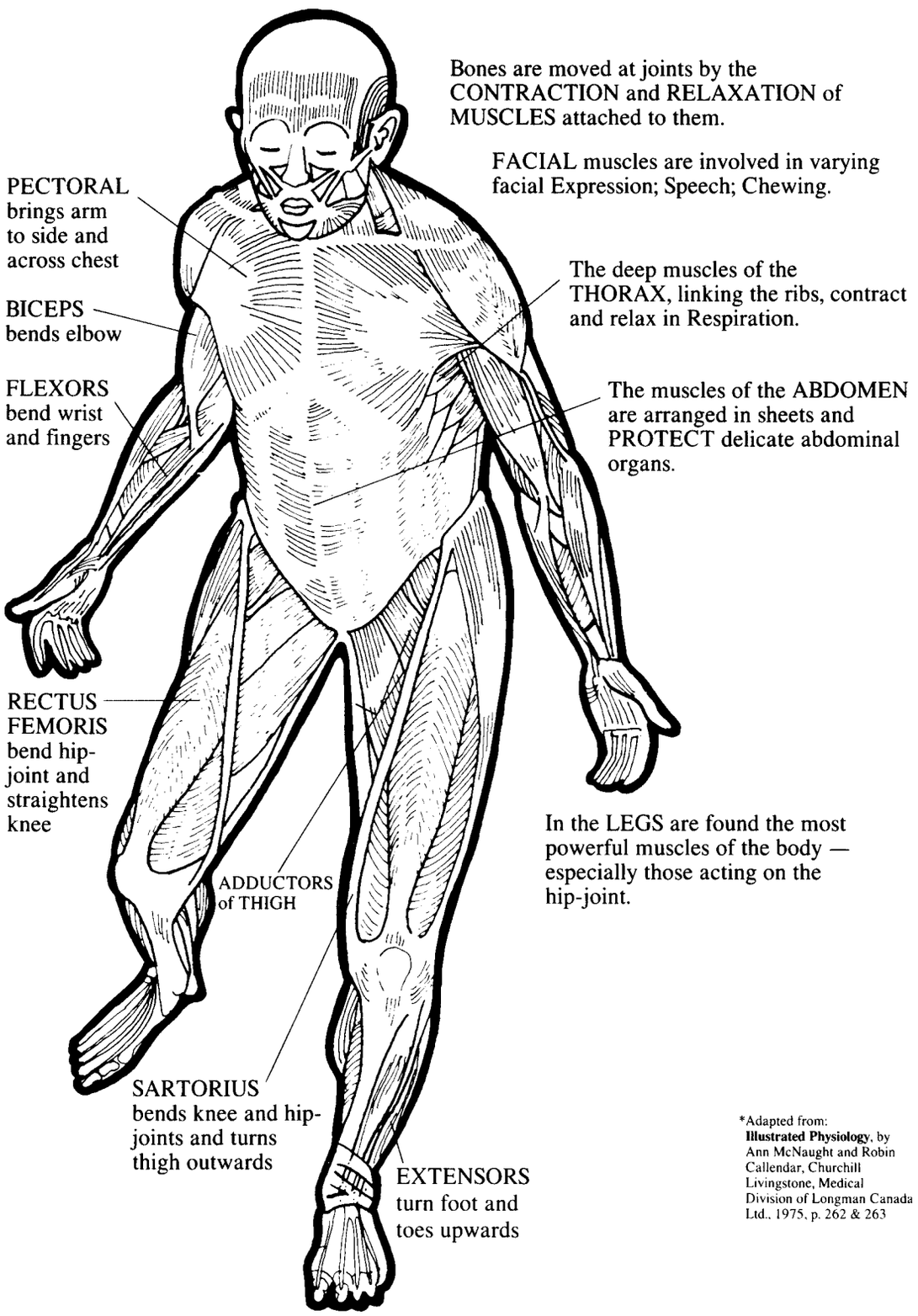
Physical conditioning is a necessary component in developing optimal performance in athletes. It is important to plan off-ice training programs to bring about changes in the players’ endurance, strength, power and flexibility. As well, it is important to realize that training programs need to be modified to meet the age, sex, and physiological development of your players.

The information in this chapter will form the base of knowledge that you will need to design effective and appropriate training programs.

12.2 The Muscular System

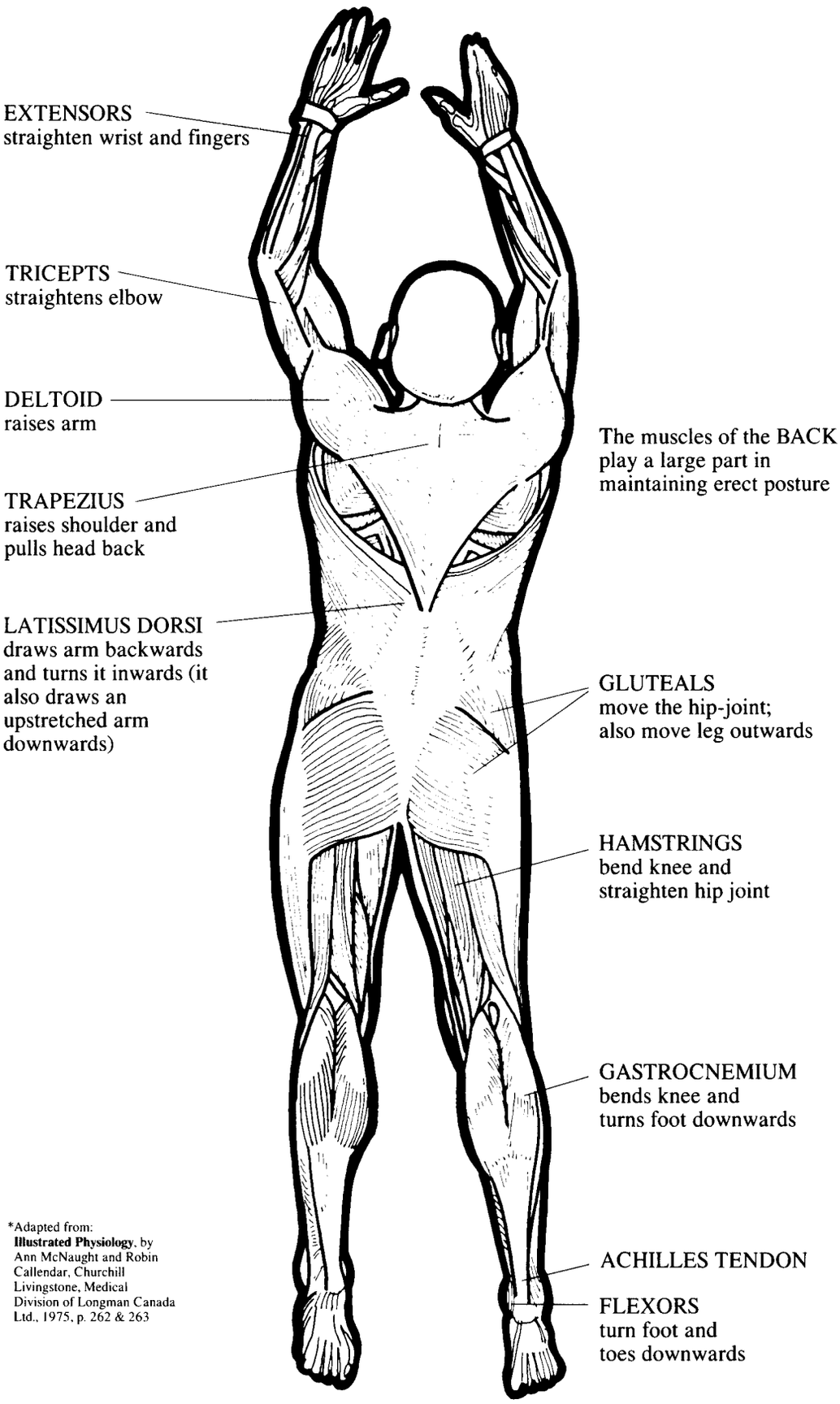
There are over 600 muscles attached around the human skeleton. The major muscle groups and their functions are illustrated in Figures 1 and 2.

Figure 1: The Skeletal Muscles



*Adapted from: **Illustrated Physiology**, by Ann McNaught and Robin Callendar, Churchill Livingstone, Medical Division of Longman Canada Ltd., 1975, p. 262 & 263

Figure 2: The Skeletal Muscles



*Adapted from:
Illustrated Physiology, by Ann McNaught and Robin Callendar, Churchill Livingstone, Medical Division of Longman Canada Ltd., 1975, p. 262 & 263

Each muscle is made up of many muscle cells which are triggered by nerves to contract and produce force. The muscles are attached to bone by tendons and when the muscles contract, they exert force on the bones via these tendons.

Most muscles are arranged in pairs with one producing movement in one direction and its partner (antagonist) producing movement in the opposite direction. For example, in the skating stride, the quadriceps extend the knee while the hamstrings flex it during the recovery phase. In this case, the hamstring is the antagonist.

Maximum forces can be achieved if one muscle group contracts and causes stretching of its partner before the partner contracts. Using the same example of the skating stride, the flexors of the knee (hamstrings) stretch the extensors (quadriceps) during the recovery phase before the quadriceps contract in the powerful extension phase of the stride.

If both muscles in a pair contract with the same force but in opposite directions, no movement results. This will occur when one wishes to hold a particular position. However, when movement is required, the nervous system inhibits one muscle group while activating its partner. When working at strength or power training, players must be very careful not to get one muscle of the pair excessively strong in relation to the partner. It can decrease flexibility and make the weaker muscle susceptible to injury.

When muscles contract to produce force, they consume energy in the form of chemical fuels. Fuels must be supplied at the rate at which they are used in order to continue working. The discussion of how this energy balance is attained is presented in the section 12.4 (The Energy System) of this module.

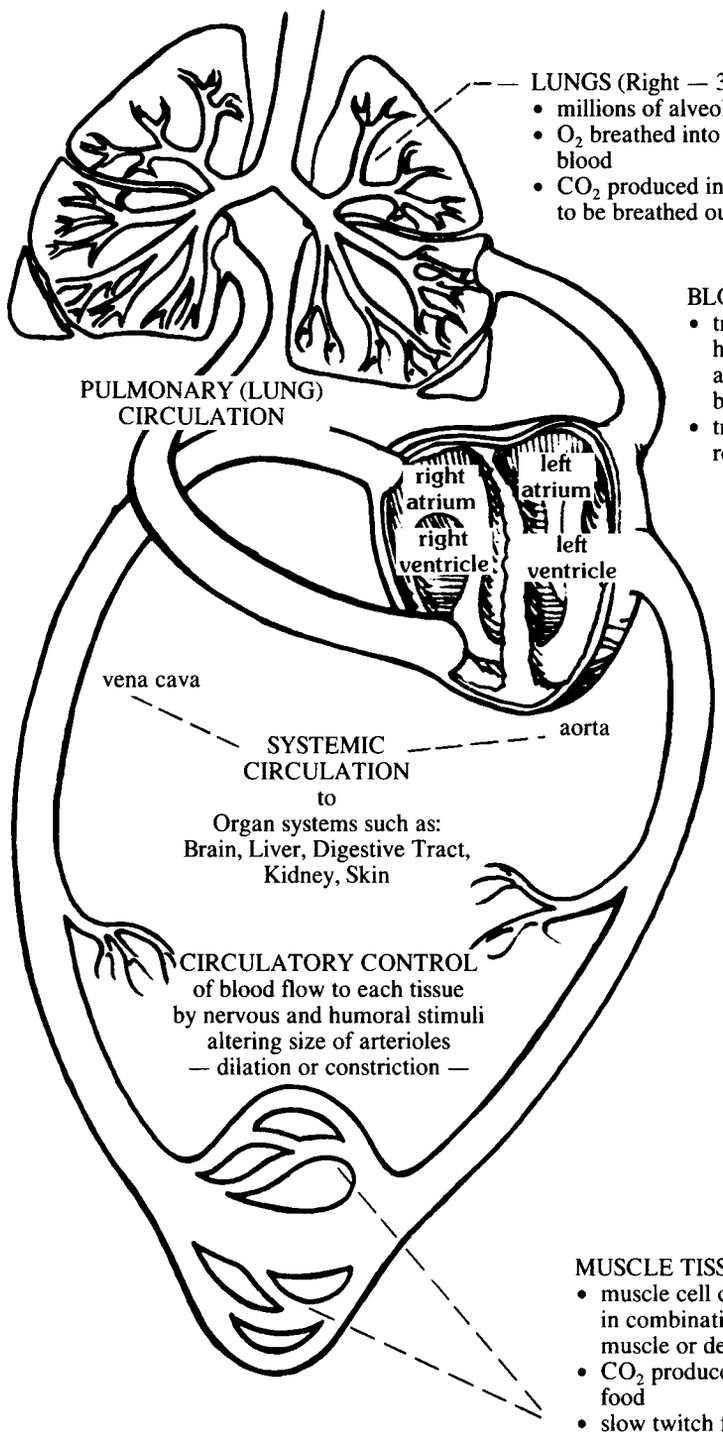
12.3 The Cardiovascular System

The human body uses the blood to transport nutrients and oxygen to each cell, to transport hormones, to remove wastes, and to act as a radiator in the convection of heat from the core to the surface.

Blood is pumped via a four-chambered heart into blood vessels which direct the blood both to and from working tissues. The amount of blood pumped per minute and the portion going to each area is proportional to the amount of work being done. Thus, active muscle gets more blood flow than inactive and the greater the activity the greater the flow. At rest, the heart pumps five litres per minute and this is increased to over 30 litres per minute during maximal exercise. The flow going to muscles can increase from about 20 percent at rest to over 80 percent during maximal exercise.

Since the supply of fuels and oxygen is important and the removal of wastes is critical for recovery from intense on-ice shifts, a well developed cardiovascular system is a fundamental prerequisite for top performance in hockey.

Figure 3: The Cardiovascular System



12.4 The Energy System

The body during activity can be thought of much like a car during motion. The car's engine consumes fuel in order to generate the power necessary to move the vehicle. The muscles in the body must also consume digested fuels (carbohydrates, fats) in order to generate the forces to perform work.

The refined automobile fuel must be supplied to the engine in order for it to be used. Small amounts of this refined fuel are stored in the storage tank. When this fuel runs out, we cannot lift the hood of the car and request "just one more kilometre and I'll give you an extra litre."

The operation of muscle is very much the same as that of the car engine. The form of fuel which the muscle can use is very refined. It is called Adenosine TriPhosphate-ATP. It is stored in limited amounts in the muscle cells and for the muscles to be able to continue to work at a certain rate, the rate of supply of ATP must be equal to its rate of consumption. The importance of the balance between energy (ATP) production and energy consumption is illustrated in Figure 4.

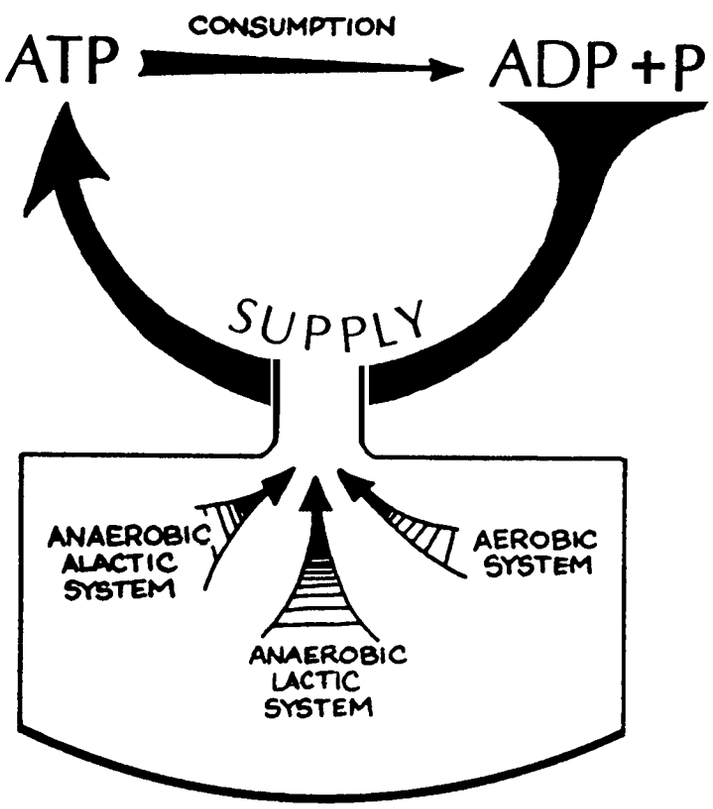


Figure 4: Balance Between Energy Production (ATP) and Energy Consumption

The Three Energy Systems

Muscle can consume energy from very high rates (e.g., during high speed or high force types of effort) to very low rates (e.g., walking, jogging, or other low intensity efforts). This is analogous to the three types of vehicles on the left of Figure 5. The high speed sports car, the high powered truck, and the low speed, highly efficient economy car. The sports car representing high velocity bursts on-ice, the truck representing strength movements, and the economy car representing prolonged endurance work. In order to meet these different demands, refining systems must supply the fuel (ATP) at the rate it is being used, otherwise the limited stores will be depleted and the rate of work can no longer be maintained.

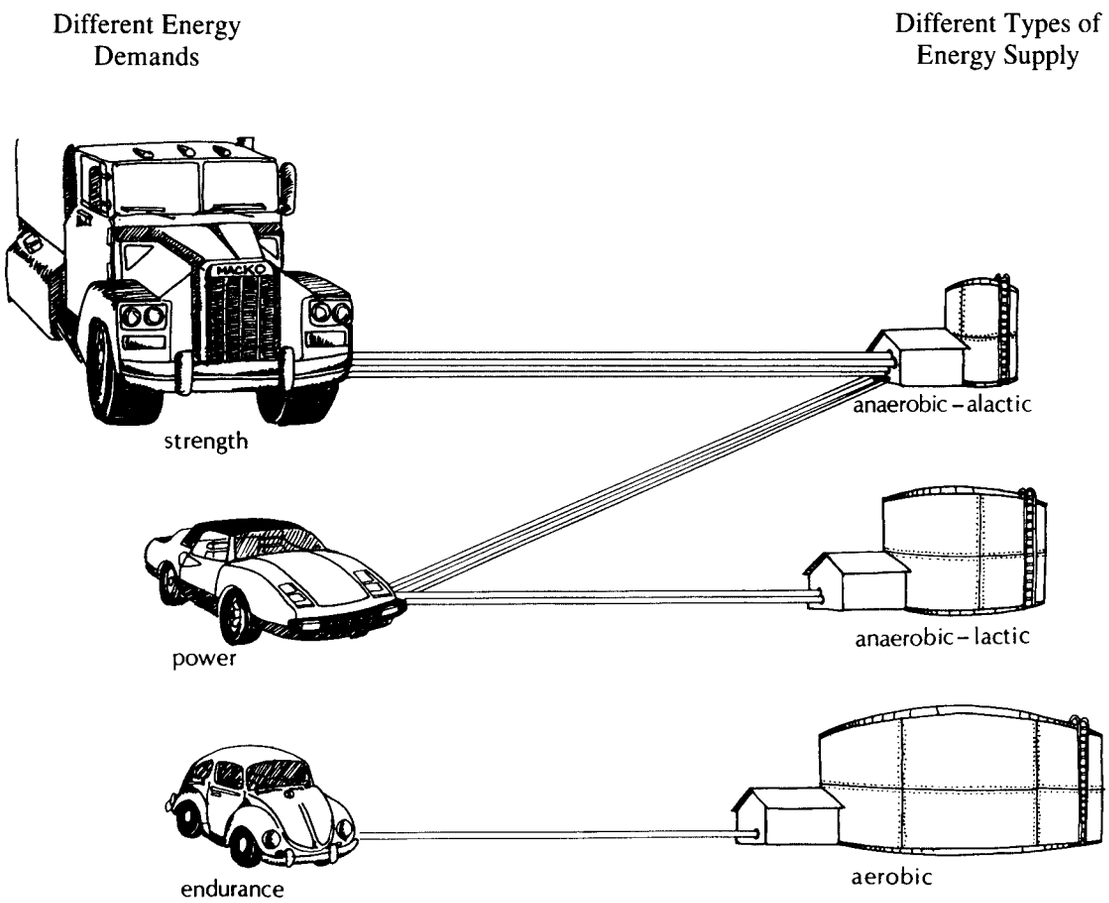


Figure 5: A Comparison of the Three Types of Muscle "Engines"

Fortunately, muscle has three different energy supply systems designed to meet the different demands. These different energy supply systems are illustrated on the right of Figure 5:

- this supply system represents an immediately available but limited store of ATP and high energy phosphates in the muscles;
- a high rate refinery for rapid production of ATP;
- a low rate but high capacity refinery for slow supply of ATP.

These energy supply systems are often categorized according to whether or not they use oxygen in the process and whether or not lactic acid is produced as a by-product. If oxygen is used, it is termed aerobic, if not, anaerobic. If lactic acid is produced, it is termed lactic, if not, alactic. The three energy systems are:

- Anaerobic Alactic
- Anaerobic Lactic
- Aerobic

Anaerobic Alactic

Immediate stores are available instantly but only last for 10-20 seconds at high rates of use. This includes the store of ATP and another high energy phosphate called creatine phosphate (CP) which restores ATP immediately. As oxygen is not used and lactic acid is not produced by these stores, it is called the anaerobic alactic system and supplies ATP at the highest rate. This system would provide extra energy for the high speed bursts during a shift.

Anaerobic Lactic

This is a high rate refinery system which supplies energy (ATP) at a very high rate but produces a pollutant (lactic acid) during the refining process. This refinery uses only carbohydrate as a raw fuel but does not require oxygen to produce ATP. However, due to the production of lactic acid this refinery can provide energy at a high rate for only 2-3 minutes. Since oxygen is not used but lactic acid is produced by this system, it is called the anaerobic lactic system. This system provides energy during skating over the whole shift.

Aerobic

This is a low rate refinery system which supplies ATP at a low rate but burns clean. This refinery uses both carbohydrates and fats as raw fuels and uses oxygen in the refining process. Since this process produces no toxic wastes it can continue for up to 23 hours before running out of raw fuels or ceasing due to over-heating or dehydration. Since oxygen is used and no lactic acid is produced by this system, it is called the aerobic system. This system replenishes the stored ATP during rest intervals and burns lactic acid as a fuel during the recovery phase.

The approximate percent contribution from each of the three energy systems for specific types of activity in hockey is presented in Table 1.

Type of Activity	Energy System		
	Anaerobic Alactic	Anaerobic Lactic	Aerobic
5 second bursts	85	10	5
10 seconds of hard skating	60	30	10
30 seconds of continuous activity	15	70	15
1 minute shift of intermittent sprints, coasting, and stops	10	60	30
Recovery between shifts/periods	5	5	90

Table 1: Approximate Percent Contribution from Each Energy System for Specific Activities in Hockey

12.5 Support Systems

The understanding of the energy balance in muscle is fundamental to understanding how the body works during hockey. However, there are also many support systems which permit the energy supply systems and the contractile machinery to operate effectively and to recover between high intensity efforts.

The cardiovascular (heart and blood vessels) and the respiratory (lungs) systems are instrumental in:

- Supplying fuels (e.g., sugar) to the muscle during recovery periods to replace the fuels used during exercise and the hormones (e.g., insulin) to help the muscle store these fuels.

- Supplying building blocks proteins and amino acids to the muscle to help build better refineries and more contractile elements. It also supplies hormones (e.g., testosterone and growth hormone) to augment the building process.

- Supplying oxygen to the muscle during work and recovery so that the aerobic refinery can replenish ATP and CP stores and reconvert lactic acid into carbohydrates.

- Flushing out lactic acid to permit more rapid recovery and therefore more training or better on-ice performance.

12.6 Age Considerations for Off-Ice Training

- For pre-pubertal athletes (6-12 years old), little gain in strength can be achieved other than that due to growth. Therefore, the major focus in off-ice training should be on the development of an aerobic base, flexibility, and coordination. These can be developed with the use of games such as soccer with an emphasis on continuous activity over a whole game and the use of relays using long distances (e.g., 800 m with equal time for rest, performing four to five repetitions).

- Bicycling is a very good aerobic activity and it uses similar muscle groups as those used in the skating stride. The duration should be 30-35 minutes if it is a continuous activity.

- Heavy resistance training for strength should be avoided for the young (6-14 years old) and older hockey players (35 plus years) for safety reasons. In the young, resistance work can be damaging to growing bones; whereas in the older group, it can cause rapid increases in blood pressure. Therefore, the focus should be on increased repetitions with low weights.

- It is important to provide adequate cooling and hydration for all age groups when training but especially the young and older players. High body temperatures or dehydration can impair performance and will put additional stress on the heart and circulation.

- A sound stretching program will be advantageous to all ages and should be emphasized with increasing age. Although flexibility does decrease with age, stretching can off-set the decrease.

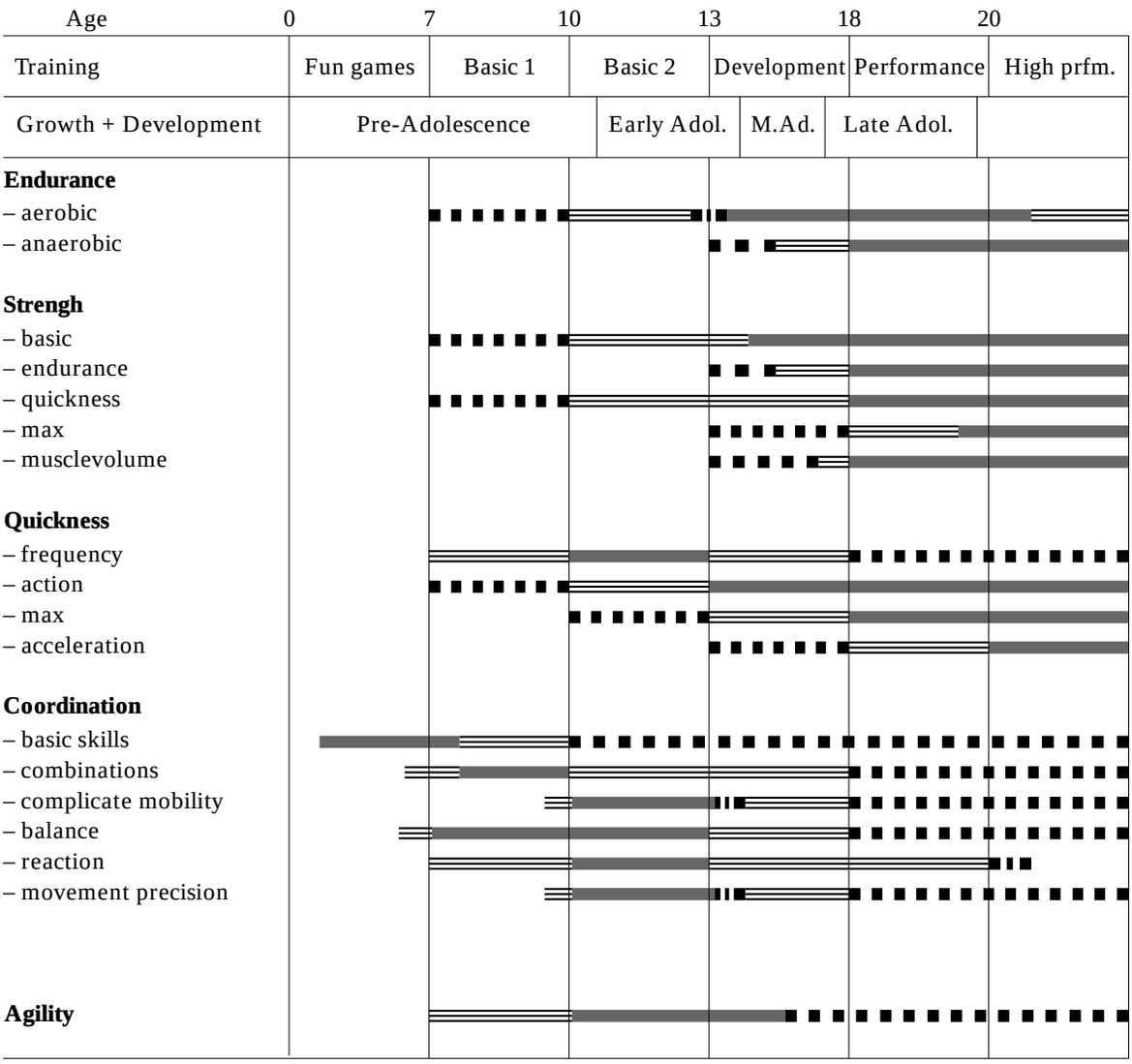
- On-ice training cannot provide an adequate stimulus to achieve the optimal amount of fitness in all components. Therefore, athletes of all ages must be motivated to train off-ice to avoid injury and to enhance performance.

- Early teens can focus on using body weight as the overload stimulus and perform situps, push-ups, jumping activities, and cycling.

- Mid to late teens can begin to load with heavy resistances off-ice to build strength. They should also perform high speed activity in hockey specific actions to ensure that power gains are related to hockey performance. It is advisable with this age group that specific programs be designed which focus on individual weaknesses.

Table 2 on page 12.11 outlines the optimal age of physical development for athletes.

Optimal Age of Physical Development



Legend

Minimal Training Effect
Average Training Effect
Optimal Training Effect

Table 2

For the Coach

Application of the Three Energy Systems and the Support Systems to Hockey.

To have effective performance in hockey, it is important for the players to have:

- Muscles which can generate high forces and recover quickly for sprint activity.
- Well-developed ***anaerobic alactic energy supply systems*** in the muscles to provide energy for the high burst activity such as break-outs and accelerations.
- Well-developed ***anaerobic lactic energy supply systems*** in the muscles to provide energy at a high rate for a full shift.
- Well-developed ***aerobic energy supply systems*** in the muscle to replenish ATP stores between shifts and between periods and to assist in reconverting lactic acid to valuable carbohydrates. This will enhance recovery from high speed shifts.
- Well developed ***support systems*** such as the cardiovascular, respiratory, and endocrine (hormonal) systems to facilitate recovery and, therefore, to enhance both performance and training.

It is therefore important to focus on the development of the energy and, support systems when planning the physical preparation of the hockey players. If a system is going to be improved, it must be overloaded beyond what it is normally required to do, As well, the training effect is specific to the muscles and joint actions involved in the training. Therefore, it becomes clear that the muscles must be overloaded in hockey specific actions to generate high bursts of power and to repeat these high power bursts in the presence of lactic acid. As a foundation, the aerobic energy supply systems and the cardiovascular, respiratory, and endocrine support systems must be well-developed to provide for proper recovery.

SELF TEST

(Answers are on the next page)

True or False

1. T F There are over 600 muscles in the body arranged mostly in antagonistic pairs.
2. T F Strength and power training should focus on both muscles in a pair.
3. T F Energy consumption can exceed production for extended periods and exercise can continue at high rates.
4. T F The cardiovascular system is important for hockey players because it transports fuels, and removes heat and wastes in recovery.
5. T F Heavy resistance training should be avoided for the young (6-14 years old) and the older (35 plus) hockey players.
6. T F Overheating and dehydration are not problems in hockey.

Match the characteristics in Column II with the appropriate energy supply system in Column I.

Column I		Column II
1. Anaerobic Alactic	_____	A. Uses oxygen in producing ATP.
2. Anaerobic Lactic	_____	B. Supplies energy immediately.
3. Aerobic	_____	C. Results in the production of lactic acid.
	_____	D. Uses only carbohydrates as a fuel.
	_____	E. Uses both fats and carbohydrates as fuel.
	_____	F. Supplies energy at maximum rate for only 10-20 seconds.

SUMMARY

- The human body contains approximately 600 muscles which are organized in pairs for producing movement.
- There are three energy supply systems:
  - Anaerobic Alactic
  - Anaerobic Lactic
  - Aerobic
- The three energy systems are called into play at different times depending on the specific activities in hockey.
- The cardiovascular and respiratory systems provide necessary support to the energy supply systems in response to activity.
- The age of the players needs to be considered when planning for off-ice training.

Answers

I. 1. T
2. T
3. F
4. T
5. T
6. F

II. A. 3
B. 1
C. 2
D. 2
E. 3
F. 1

13. DEVELOPING FITNESS

FAIR PLAY
AND RESPECT

13. Developing Fitness

There are many reasons why young hockey players should develop high levels of fitness: they will be less prone to injury; they will recover faster so they can practice their skills more often; they will be able to use their skills more effectively they will have more fun playing hockey. Of course, as they build better levels of fitness they will get more enjoyment out of other aspects of their lives.

Upon completion of this chapter, you will be better prepared to:

- *incorporate into your team's yearly planning the important components of fitness, endurance, strength, power, agility, balance and coordination,*
- *design training programs specific to the age groups that you are coaching,*
- *understand the importance of warm-up, cool down and stretching for games and practices.*

13.1 Relationship Between Fitness Components and Age Differences

There are many factors which contribute to "fitness" and each of these plays a more important role for different age groups. The important fitness components for hockey players are:

- Endurance
- Strength
- Power

The ABC's are:

- Agility
- Balance
- Coordination

Endurance

Endurance permits rapid recovery between bursts, between shifts, between periods, and between games. It also helps tolerate heat and to offset the detrimental effects of travel.

Strength

Strength offers protection from impact and gives more stability on the puck and the ability to establish position in front of the net and move others off the puck in the corners.

Power

Power affords good acceleration, braking and a high velocity shot.

The ABC's

The ABC's are fundamental to skill development and therefore to tactics and strategies as well.

Agility

Agility is the ability to change direction quickly in a confined space. If your players' tight turns and sudden stops are not good, they need to work on their agility.

Balance

Balance is the ability to keep the body's centre of gravity over its supporting base so as not to fall down. If you find your players are falling down often, then they may need to work on their balance.

Coordination

Coordination is the ability to link precise movements of different parts of the body. If your players have trouble skating when trying to carry the puck, then they may need to work on their coordination.

Different components should be emphasized at the different age groups. For 9-12 year olds, the ABC's should receive top priority. For 13-16 year olds, the ABC's are still important because growth rate may exceed coordination, but the development of endurance is necessary to lay the foundation for building strength and power as the player progresses through this age range. For the 17-20 year olds, the further development of endurance, strength and power will enhance performance through better decision making, explosive power and ability to physically control opponents.

13.2 Developing the ABC's (Agility, Balance and Coordination)

This should be the major focus for the 9-12 year olds and should still be used for 13-16 and 17-20 year olds. Agility, balance and coordination are three parts of fitness which are referred to as "athletic ability". When you say somebody is a good athlete, you usually mean that person has good agility, balance and coordination.

But it is not just sports which require athletic agility. Every active game, such as tag or leap frog, requires agility, balance and coordination. Thus, by playing enjoyable games, you can improve your fitness and getting fit can be fun.

For the Coach:

Here are some fun things coaches can use to improve agility, balance and coordination both on and off the ice.

Off-Ice Activities:

- Any relay race or game which forces players to change direction rapidly is a good ABC fitness builder.
- Have players run the circular agility course shown in Figure 1, adding progressively more difficult movements, such as dribbling a soccer ball with the feet, or a basketball with the hands, or juggling tennis balls. Players could be moving in the opposite direction of each other and must avoid running into each other.
- Use your imagination and come up with games which challenge the levels of coordination, balance and agility which your players already possess.
- Encourage young players to participate in all sports because the athletic ability which they develop and derive from other sports will carry over into their hockey and make them better players.

Figure 1: A Circular Agility Course

On-Ice Activities:

- Weaving drills while dribbling balls, juggling, stick handling, or controlling the puck with the feet are excellent.
- Relays which incorporate quick changes in direction, such as tight turns around pylons, and involve multiple movements of arms and legs, are also very good.

13.3 Developing Endurance and Recovery

This should be emphasized in both the 13-16 and 17-20 year old groups and, ideally, it is best to build it in the summer before the season starts. Their endurance/recovery system relies on:

- the heart and vascular system which carries oxygen in the blood, and
- the muscles which must be conditioned to work hard for longer periods of time, resisting fatigue and recovering quickly.

Exercise which challenges these two systems is termed “aerobic”, meaning “with oxygen”. Athletes develop their circulation system by aerobic exercises which use large amounts of muscle for time period of 30-60 minutes.

Activities such as crosscountry skiing, distance skating on a lake or oval, continuous skating on a rink, rollerskating, cycling (stationary or bicycling), running, swimming and skipping can be used to challenge the central component of aerobic fitness. The intensity should be at a level where players can just carry on a conversation and it should be 4-5 times per week. It is ideal to build this component of fitness during spring and summer so that your players have a good recovery system when they begin their hockey season.

Your players can build endurance fitness in their hockey muscles with activities which closely simulate hockey actions done in 2-3 minute intervals of work with 2-3 minutes of recovery and progressing from 6-10 repetitions per session. Cross-country skiing, rollerskating (single file wheels), cycling (stationary or bicycling), the slide-stride board or interval skating all mimic hockey actions and are effective.

In summary, the endurance/recovery, or aerobic system, has two important components:

- The cardiovascular system can be improved through many activities which use large muscles for 30-60 minutes continuously, and
- The hockey specific muscles which build aerobic fitness with 2-3 minute work to rest ratios in activities which closely simulate hockey actions.

13.4 Developing Strength

Strength is the ability to produce force through the contraction of muscles. Should your athletes discover that opposing players can lift their sticks or easily push them off the puck, a natural conclusion might be that there is a need to develop upper body strength. As well, your players will be more stable on their skates and will be able to execute more powerful skating strides through the development of leg strength.

Building up strength in all muscles is important. But wherever possible working on the specific muscles used in hockey should be emphasized. Strength in the upper body becomes more important with increasing age because the physical jousting of body contact comes into play and strength protects joints from injuries.

Strength can be increased in two ways:

- by increasing the size of the existing muscles, and
- by using the existing muscles more effectively.

Developing Strength in 9-12 Year Olds

Adults can increase their strength by building more muscle through weight lifting. But players in the 9-12 age bracket do not have the body hormones necessary to build more muscle, and lifting weights too heavy could damage their growing bones.

Fortunately, there is another way to build strength, and that is by learning how to use existing muscles more effectively. This is the only way to increase the strength of a 9-12 year old player.

For muscles to become stronger they must work against resistance for a period of time. This resistance for 9-12 year old players should not be more than their own body weight. Working in pairs is a good way to develop strength, where partners provide resistance for each other. Light weights (that they could lift at least 25 times in succession) can be used too.

For the Coach:

There are several fun things you can do to improve your players' strength both on and off the ice.

Off-Ice Activities:

- Push-ups, sit-ups, chin-ups, leg pushes with a partner, and stick exercises are all challenging ways to improve their strength.

On-Ice Activities:

- Partner-resisted skating drills both forward and backward automatically work on the skating muscles.
- Face-off resistance drills and stick struggles are good strength builders.

Developing Strength in 13-16 Year Olds

Since hormone production, which is necessary for increasing muscle size is on the rise or has peaked, a 13-16 year old player can build strength in both ways mentioned above.

For muscles to become stronger they must work against resistance for a period of time. However, because of the rapid growth at the 13-14 age, it is wise to keep the resistance relatively low and do a high number of repetitions; say a set of 15-20 reps at one time. Using their own body weight, slight resistance from a partner, or light free weights is ideal.

In the 15-16 age category, resistance can be added so that only 10-12 reps in one set are possible.

For the Coach:

Off-Ice Activities:

- A training circuit can be set up in a gym or outdoors. It can be fun in a challenging way, and players should choose partners of similar size and weight. Set the circuit up to alternate between upper body and lower body activities. Some players might repeat certain stations if they need extra work in specific areas.

A bicycle tire inner tube is a very handy item to use for strength and power training. It is inexpensive, portable and can be used in many ways. Free weights are also very good.

On-Ice Activities:

- Activities can be arranged into a circuit with one minute for each partner at each station with ten second transit times between stations. Coaches can signal station changes and partner changes. In partner-resisted skating, partners change after each length.

Developing Strength in 17-20 Year Olds

Strength is important for a 17-20 year old hockey player to protect joints and internal organs from injury. Strength also enhances their hockey performance by increasing their stability which helps them to establish their position and move opponents off the puck.

Optimal hockey strength gains are achieved by loading the muscles with resistance in movements in which strength is required. The ideal amount of load is that which players can lift only ten times. This is called the 10 RM – repetition maximum in each exercise. A complete group of exercises is called a set and athletes should build from one to two to three sets gradually.

General strength programs which use free weights or resistance equipment can be effective and have some carry over into hockey performance. However, for on-ice strength, the use of partner resistance and bicycle tubes or surgical tubing can be even more effective because the load can be applied in specific hockey actions.

Guidelines

Players can develop their strength in a fitness centre, health club, or a gym. Here are some important guidelines to follow when strength training.

- It is better to start with loads which are too light than too heavy.
- When using free weights, work with a partner who can “spot” for safety.
- Alternate an upper body exercise with a lower body exercise.
- Muscles are organized in pairs around each joint. Train both groups in the pair.
- Performing ten repetitions of the load which athletes can do ten times (10 RM) gives the best improvements. Build from one to two to three sets over the first six weeks.
- When a player can do more than 12 repetitions in their third set, increase the load.
- For general strength, select exercises which build the muscles around the shoulders, chest, abdomen, elbow, wrist, hip, knee and ankle,
- For hockey specific strength, choose exercises which simulate hockey movements. Athletes can design their own using a bicycle inner tube or surgical tubing and a hockey stick shaft.
- Strength train only three times a week (on alternate days) to allow time for muscles to recover and build.

There are a wide range of partner-resisted exercises which an athlete can do, either on or off the ice, to increase strength. Partner-resisted include push-ups, sit-ups, chin-ups, leg presses, scissors, stick struggles, skating and single armed puck protections.

13.5 Developing Power

Power training and extending high power over longer durations should be introduced in the latter years of the 13-16 year olds and then further emphasized in the 17-20 year olds. High speed sprints on-ice are sufficient load for the younger groups and avoid the explosive jumps which are risky for the younger less skilled players.

Because the game is based on speed, power in the lower body is very important. High power means faster starts, more rapid acceleration and a better ability to drive to the net, to get in the open, or to close off defensive openings.

However, good upper body power is important, it results in more rapid application of force which permits players to have better opportunities to establish position, shove opponents off the puck and to shoot quickly with power.

The best way to train for speed is to use explosive actions. An effective way to do this is to rapidly stretch a muscle, then explosively contract it. This technique is called plyometrics and it is an important type of exercise to develop hockey fitness.

For instance, stretching the leg extensors occurs when an athlete lands from a jump, then follows it with an explosive jump. Note that higher jumps give more stretch but jumping from heights (e.g., benches) should be progressed to gradually and should not be used on ice because of the instability of skates.

Exercises using plyometrics should closely mimic hockey actions. Here are some on or off-ice activities which can be effective.

- laterally jumping over lines, pylons or benches using one or two legs,
- jumping crossovers across lines on-ice or into hoops on a gym floor,
- partners lock feet to back of each other's calves in sit-up position facing one another,
- partner throws medicine ball above head to opposite number, opposite number catches it, leans back and explodes forward, throwing ball to partner,
- swing dumbbells forward and backward with arms in skating motion,
- roll soccer ball to partner who cradles it with stick and explosively shoots it back.

These exercises should be done no more than 2-3 times per week. This rapid stretching will result in some muscle soreness up to two days later.

These types of power developing activities can be organized into a circuit with alternating upper and lower body activities. Keep the time spent at each station short (10-20 seconds) to keep the quality of activity high.

Explosive power is very important but players must also be able to extend high speed skating for longer and longer periods. With high power activity, the working muscles produce lactic acid as they produce energy. This lactic acid causes rapid fatigue and decreased performance. Muscles therefore must be trained to tolerate this acid during high power work, letting the aerobic system remove it during recovery.

Training to extend power in the legs is done by increasing the duration of high speed sprints from 5-10 to 15-20 seconds, then resting for three times as long while three other waves of players go. Then repeat up to 5-6 times. The best training results are obtained on-ice, but with activities which simulate the hockey stride it can also be effective off-ice.

13.6 Using Warm-Up, Cool Down and Stretching Prior To and Following Practices and Games

Warm-Up

A warm-up has both a physical and a mental component. It is important mentally to begin to focus on the objectives of the practice and/or game and to become mentally committed to giving quality and effort. The physical portion of the warm-up is designed to increase blood flow to the muscles and to elevate the temperature of the muscles. As such, a warm-up should be started slowly and increased gradually in intensity. It should use large muscle groups in movements similar to hockey. It can begin in the dressing room and be completed on the ice and should last 10-15 minutes.

Static or 3-S stretching (see Flexibility below) should precede the warm-up to relax the muscles and, therefore, to assist the blood flow and to permit full range of motion with a reduced risk of injury. On-ice warm-up can begin with slow stretching and must proceed from slow to quick activities. It should include forward and backward skating with the use of all edges in striding, crossovers, tight-turns, and stopping. It should also blend in upper body actions to prepare for shooting and impact.

The warm-up effect begins to decrease as soon as the warm-up activity ends and it is unlikely that much benefit exists after 30 minutes. Therefore, ensure that the transition between the warm-up and the game or the practice is short.

Cool Down

The cool down has both a physical and a mental component as well. It is important to mentally relax and “come down” after a game or practice. The physical relaxation can assist this “coming down” and accomplish some physiological ends of its own. It is designed to flush out and burn-off waste produces (e.g., lactic acid) which have built up in the muscles, to reestablish fluid balance, and to relax the muscles which are tight due to hard work.

The cool down should include exercises which focus on the legs, such as slow rhythmical striding on-ice and gradually decrease in intensity, or can involve slow jogging, walking, or light calisthenics off-ice. Light calisthenics may be done in the dressing room for ten minutes following the game or practice and should then be followed by static or 3-S stretching to halt muscle spasms and to enhance blood flow.

Flexibility

Flexibility

Flexibility is the ability to move through a full range of motion around a joint. It is limited by:

- the structure of the joint.
- the balance between the muscle groups on each side of the joint.

There is little that training can do to affect the bone and ligament structures around the joint. Therefore, flexibility training is focused on increasing the range of motion by permitting one muscle to move through the full range in one direction with little resistance from the opposite muscle, and vice-versa.

The muscle pairs around a joint are controlled by the nervous system with both signals to and from the muscles. When one group is contracting, the muscles on the opposite side of a joint are relaxed. When a muscle is being stretched, however, the nervous system tells it to contract to avoid injury. Therefore, at the ends of the range of motion as the opposite muscle group is further stretched, it is also being told to contract; this further limits any increase in the range of motion.

Stretched muscles can be relaxed and then have their range increased by either of two methods:

- Static stretching which takes the appropriate muscles to full stretch at the end of the range; then holding it there for 15 seconds. The player then slowly stretches further and holds it again for 15 seconds. This should be repeated three times.
- 3-S stretching which is based on proprioceptive neuromuscular facilitation (PNF). This method requires the use of a partner. The player takes the muscles to full stretch (as in static stretching) and then with a partner resisting, the player tries to contract the stretched muscles and holds the contraction for six seconds. The athlete then relaxes and the partner, with slight pressure helps to move the joint further through the range. This entire procedure is then repeated two more times.

Note:

Ballistic stretching (high speed or bounding) is not recommended. It can produce injury and the rapid stretch actually results in a restricted range rather than an extended one.

In training for flexibility, it is important for players to note the following:

- Stretching should focus on those joints which require full range of motion in hockey specific actions (like shoulder).
- The feeling should be one of stretch not pain.
- It can be done in the dressing room prior to on-ice sessions to conserve valuable ice time.
- It should precede and follow practices, games, and dry-land training sessions.
- Stretching should be the first stage of warm-up and the last stage of the cool down and can be done as an end in itself.

SUMMARY

General Rules for Fitness Training in 9-12 Year Old Players

- Do something for fitness (on-ice or off-ice) at least three or four times a week.
- Never use resistance more than the athletes own body weight.
- If using light weights, make sure players can do 20-25 repetitions one after another. If they can't, the weights are too heavy.
- For off-ice activities, ensure athletes wear shoes with good cushion soles to absorb the shock of running and jumping.
- Do not run these athletes more than three to four miles at one time. That is a sensible aerobic limit for 9-12 year olds.
- Do not run this age group long distances on hard surfaces, such as paved roads or concrete.
- Arrange for off-ice activities in a cool environment to avoid overheating.
- Athletes should drink lots of water during all on and off-ice fitness training sessions. This helps to prevent dehydration, which happens when the body runs low on water. Dehydration can curb top performance and may cause players to feel ill.
- Choose fitness activities which are fun. That way participants will do them longer and get more fitness benefits.

General Rules for Fitness Training in 13-16 Year Old Players

- Arrange for these athletes' fitness (on-ice or off-ice) at least three or four times a week.
- Start and finish every training session by stretching, using slow movements and holding at the end of the range of motion for 20 seconds.
- For off-ice activities, wear shoes with good cushion soles to absorb the shock of running and jumping.
- Do not run these athletes more than five miles at one time.
- Do not run them long distances on hard surfaces, such as paved roads or concrete.
- Plan off-ice activities in a cool environment to avoid overheating.
- To prevent dehydration, drink lots of water (100 ml of cool to cold water every 10-15 minutes) during all on and off-ice fitness training sessions. Dehydration occurs when the body runs low on water, curbing top performance and may cause illness.
- Set goals, establish rewards and think positively. In other words, encourage your athletes to be fit.

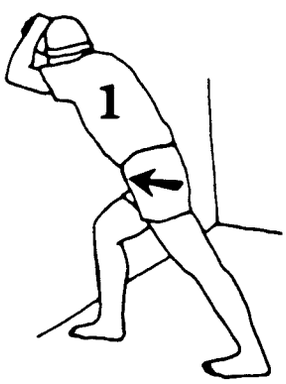
General Rules for Fitness Training for 17-20 Year Old Hockey Players

- Train for fitness four times per week.
- Precede and follow each session with static slow stretching.
- During off-ice activity, wear well-cushioned and good fitting shoes to absorb the shock of running and jumping.
- Avoid running on concrete surfaces.
- Avoid prolonged exercise in the heat of day during the summer.
- Drink at least one litre of cold water prior to training and one litre during training for each hour of heavy exercise.
- The development of the endurance/recovery system provides excellent support for all aspects of training and for performance too.

APPENDIX 13.1

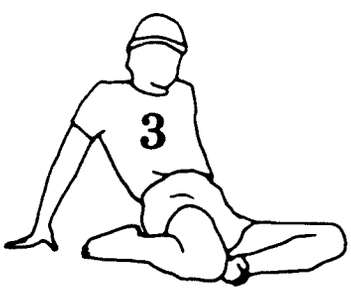
Before and After Hockey

Approximately 10 Minutes



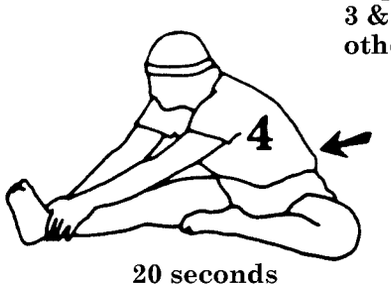
30 seconds
each leg

30 seconds



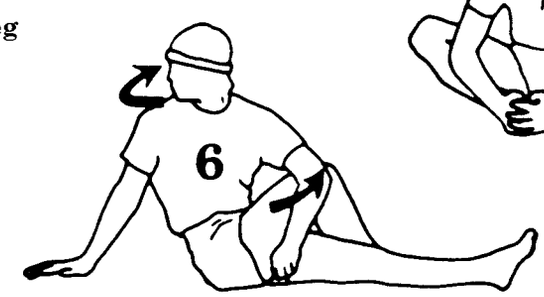
20 seconds

5
Repeat
3 & 4
other leg



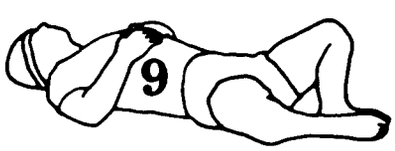
20 seconds

30 seconds

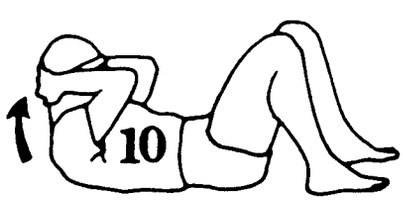


10 seconds
each side

30 seconds



20 seconds

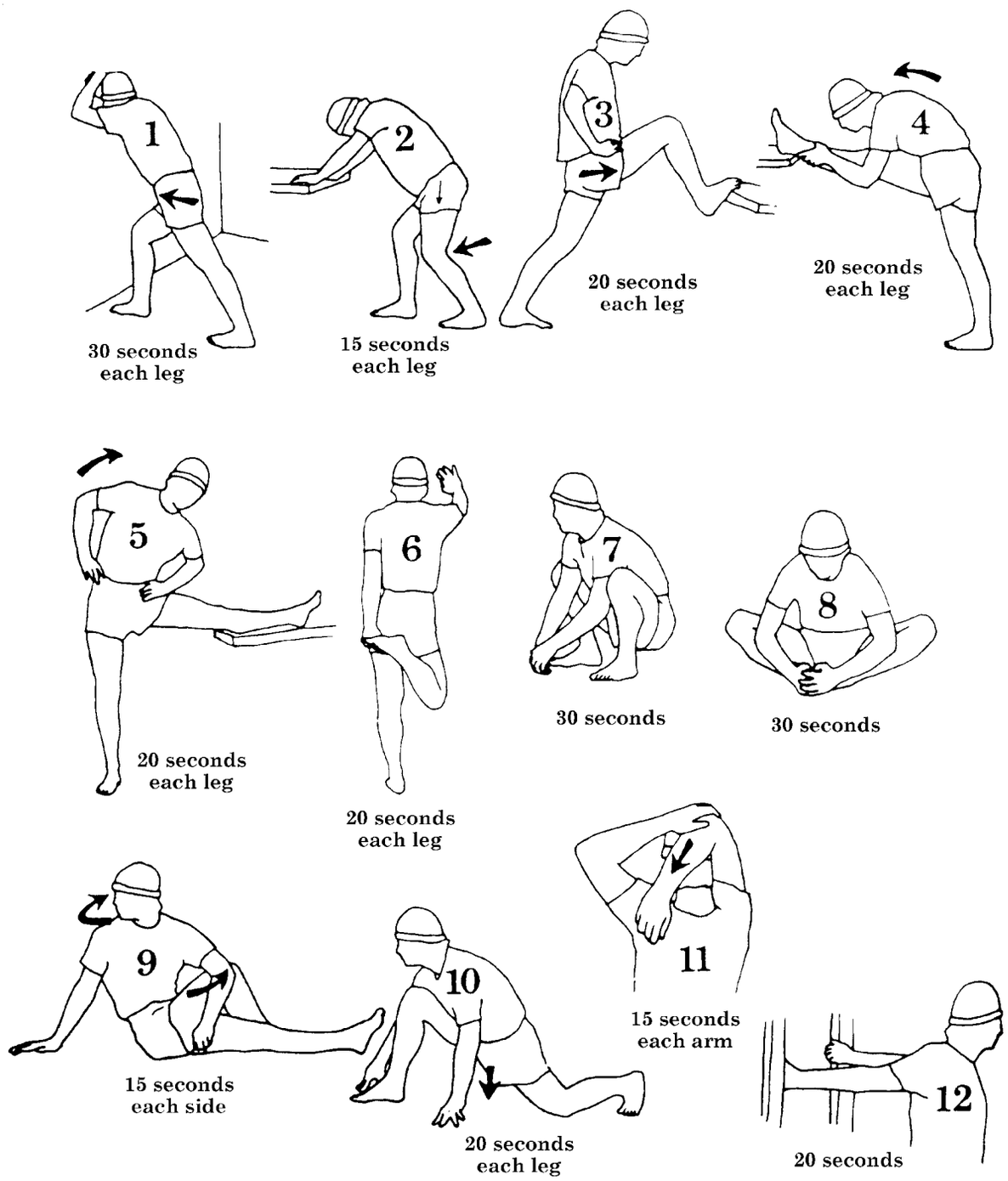


3 times
5 seconds each

APPENDIX 13.2

Before Running

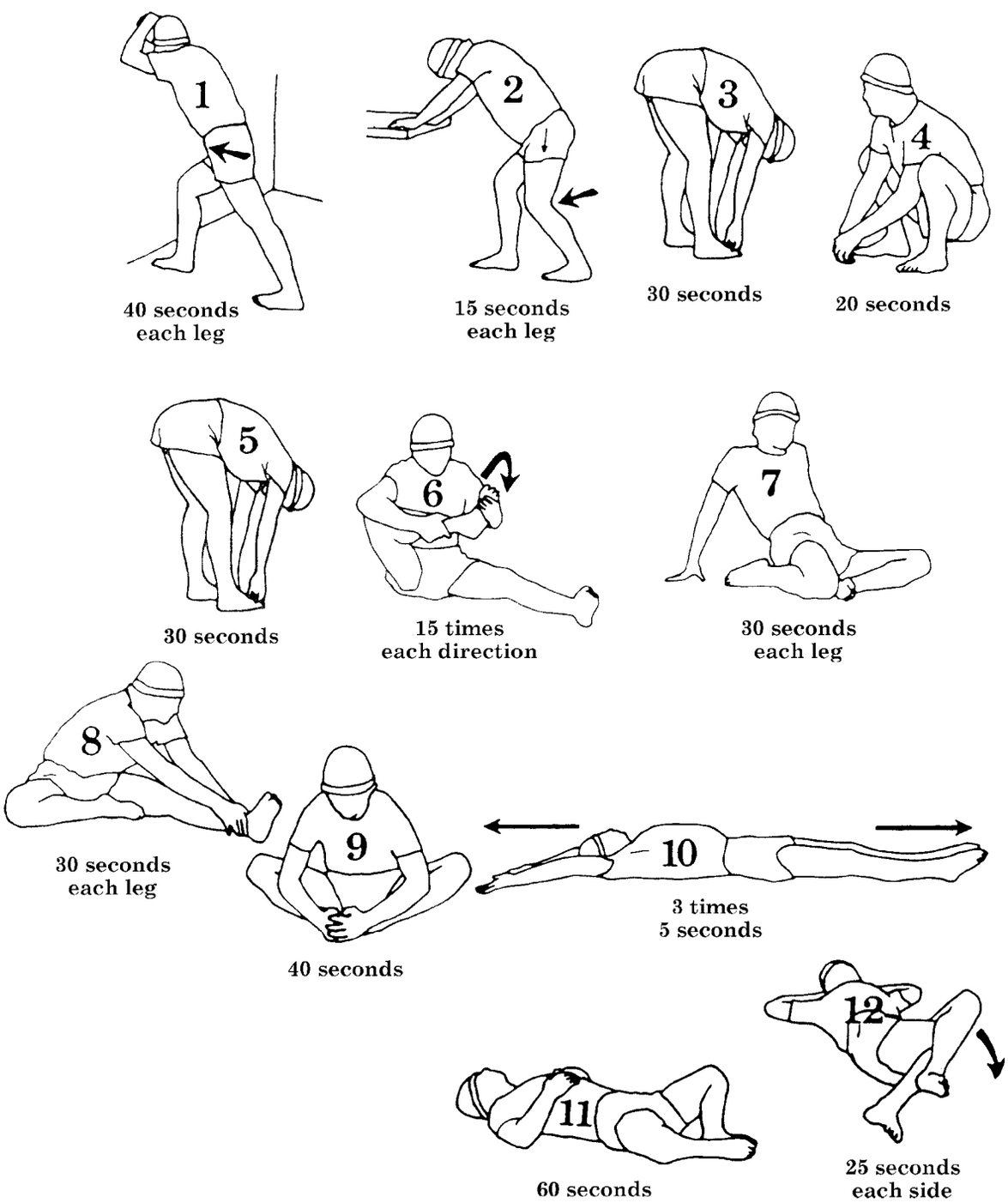
Approximately 9 Minutes



APPENDIX 13.3

After Running

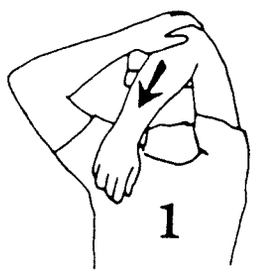
Approximately 9 Minutes



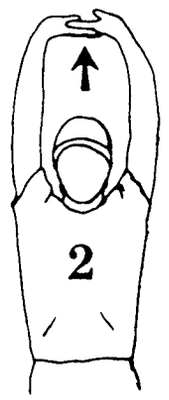
APPENDIX 13.4

Before and After Weight Training

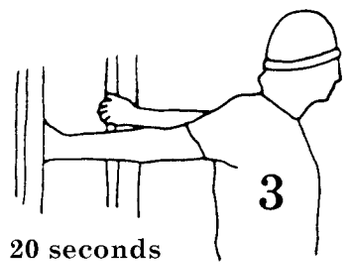
Approximately 10 Minutes



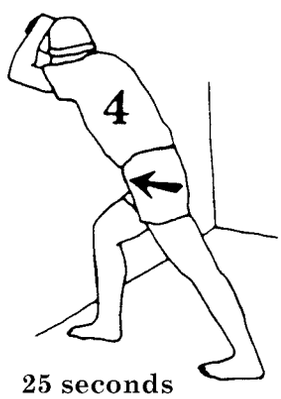
15 seconds
each arm



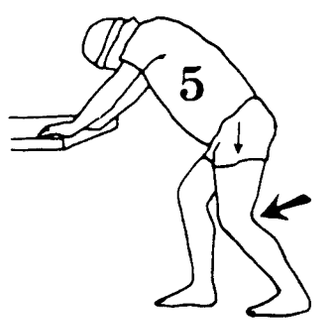
20 seconds



20 seconds

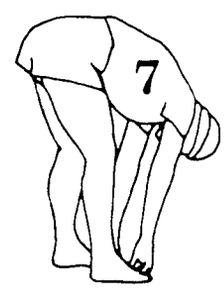


25 seconds
each leg



15 seconds
each leg

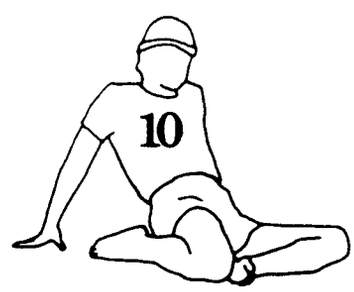
30 seconds



30 seconds

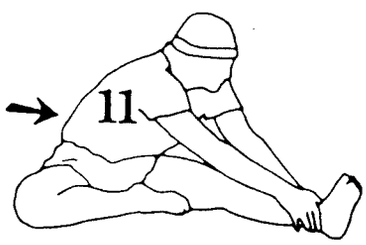
20 seconds

30 seconds

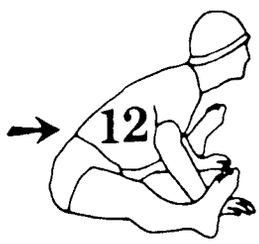


25 seconds
each leg

APPENDIX 13.4 (cont'd)

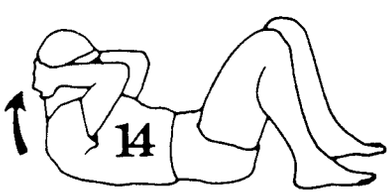


25 seconds
each leg

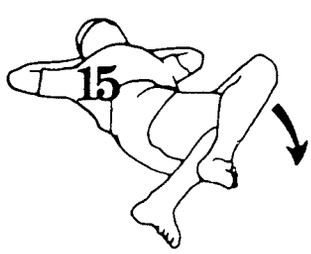


30 seconds

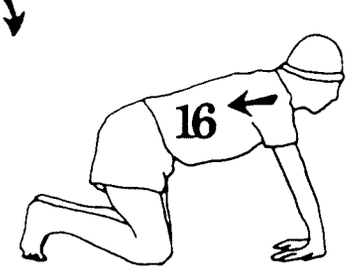
20 seconds



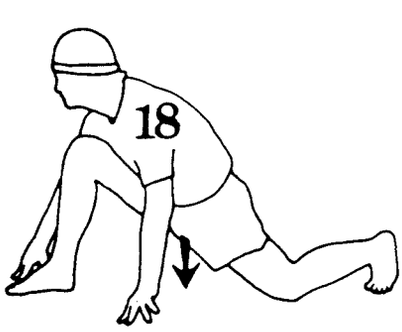
3 times
5 seconds each



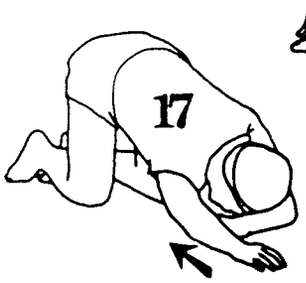
20 seconds
each leg



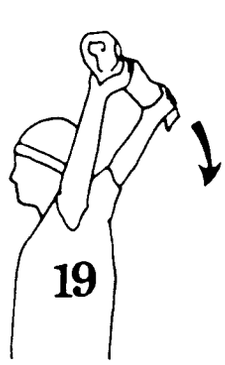
20 seconds



20 seconds
each leg



15 seconds
each arm



5 times

Notes