Section 4:
Health-Related Fitness Assessment Protocols

SECTION 4: HEALTH-RELATED FITNESS ASSESSMENT PROTOCOLS

Various fitness tasks or tests have traditionally been used to measure health-related physical fitness, which consists of three components:

1. muscular strength, endurance, and flexibility
2. body composition
3. cardiovascular endurance

To ensure thorough measurement of all three health-related fitness components, this resource outlines a variety of fitness assessment task options for each component. The diversity of assessment task options for each fitness component is intended to

- provide students, including those with special needs, the maximum opportunity to participate in fitness assessment
- provide choice, since a different assessment task can be used each time an assessment is done
- teach students that physical fitness cannot be assessed by one specific assessment task alone

Review the fitness assessment task options described on the following pages and select tasks based on their most appropriate use, given the characteristics and needs of a particular student and/or group. When choosing a fitness assessment task, check for reliability, validity, developmental appropriateness, ease of administration, and safety considerations.

Throughout fitness assessment, focus on fitness management and motivation towards participation in physical activity. Comparing student scores and using extrinsic rewards are discouraged. Use fitness testing or assessment as a strategy to help students monitor their own progress and set personal goals. The use of individual goal-setting techniques encourages students to focus on personal improvement and progress towards achieving personal goals rather than on making comparisons.

Muscular Strength, Endurance, and Flexibility

Teaching Concepts Related to Muscular Strength, Endurance, and Flexibility

Address the following teaching concepts when administering fitness tasks for muscular strength, endurance, and flexibility.

Definitions

- **Muscular strength:** The maximum force that can be exerted in a single effort.
- **Muscular endurance:** The ability of a muscle or group of muscles to exert force over an extended period of time.
- **Muscular flexibility:** The ability of a joint to move through a full range of motion.

Physiology

Physiology concepts:

- Ligaments hold bones together at joints.
- Tendons attach muscles to bones.
- Muscles move bones, which produces body movement.
- Muscles are composed of many fibres.
- Muscle fibres are grouped into motor units (neural components).
- When the difficulty of exercise is increased, more motor units are called upon to perform that exercise.
- Regular resistance exercise will enlarge and strengthen muscle fibres, improve neural function, and improve blood supply.
- Flexibility is limited by bones, muscles, ligaments, tendons, and bone joint capsules.

Training Guidelines

Overload:

- To develop strength, increase resistance.
- Increase resistance gradually as strength improves.
- To develop endurance, decrease resistance and gradually increase repetitions.

Specificity:

- To develop strength, muscles must work against a heavy resistance.
- To develop endurance, muscles must work repeatedly against a light/moderate resistance. For example, in calisthenics (e.g., push-ups, pull-ups, dips), personal body weight serves as the resistance.

Progression:

- To develop strength and endurance, add weight, perform more repetitions, and work the muscles more often.

Regularity:

- To develop strength and endurance, exercise every second day.

Flexibility development:

- Flexibility exercises are joint specific.
- Flexibility exercise should be performed daily.
- Slow stretching movements should be performed through a full range of motion, thereby providing for a permanent range of motion in joints.
- Stretching for cool-down develops flexibility.

Benefits

Improved strength and endurance

- increase success in all physical activity
- contribute to good posture
- prevent and alleviate low back pain
- allow daily activities to be conducted with more ease
- allow body weight to be manipulated more efficiently

Improved flexibility

- makes physical movements more efficient and easier to perform
- reduces muscle injury
- relieves muscle soreness
- decreases back problems
- improves posture

Implications

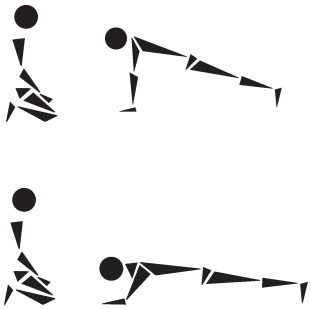
- Use of weights requires adequate preliminary instruction.
- Body weight is the recommended resistance for young children.
- It is important to develop all the muscles and to maintain a balanced development.
- Flexibility is best developed in a relaxed atmosphere.
- Flexibility development is most effective when moving each body part through a full range of motion.
- Slow, sustained movement is better than ballistic (jerking) movements.

Fitness Assessment Task Options

The fitness assessment task options for developing muscular strength, endurance, and flexibility are described on the following pages.

Fitness Component	Task Options
• Muscular Strength and/or Endurance	– Push-Up – Pull-Up – Modified Pull-Up – Flexed Arm-Hang – Curl-Up
• Flexibility	– Modified Sit and Reach – Shoulder Stretch

Push-Up



Purpose

- To assess upper body strength.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Total number of repetitions performed at a rhythmic pace.

Required Equipment

- Metronome (set to beep once every three seconds or 20 times per minute).

Administrative Suggestions

- Provide students with an opportunity to experience/practise the correct technique before they start the task.
- Students could be assessed in pairs. One student executes the push-up and the partner counts the repetitions. The partner counts only the push-ups that are demonstrated correctly.
- Partners can check for accuracy of technique by placing both fists (one on top of the other) under the participant's shoulder or chest at a height where elbows attain a 90-degree bend. During the push-up, the participant lowers the body only enough to contact the partner's hand.

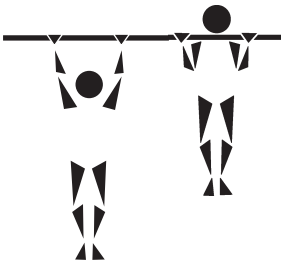
Protocol

1. Lie on the floor (face down) with hands placed under the shoulders, fingers pointed forward, and legs straight and together with toes tucked under so that they are in contact with the floor. Then push until the arms are fully extended, keeping legs and back straight. This is the **up position**.
2. Lower the body using the arms, keeping the back in a straight line from head to toes until the elbows reach 90 degrees and the upper arms are parallel to the floor. This is the **down position**.
3. The task begins in the up position. One complete push-up (repetition) is counted when the student completes a cycle of up-down-up at the specified pace.
4. Inability to keep pace with the "beeps" or to maintain the correct form on two consecutive repetitions indicates the task is over.
5. The score is the total number of push-ups (repetitions) performed correctly without stopping.

Interpretation of Results

- The push-up has been identified as a good indicator of upper body strength.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Pull-Up



Purpose

- To assess upper body strength.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Total number of repetitions performed correctly without rest.

Required Equipment

- Elevated horizontal bar.

Administrative Suggestions

- The use of a platform (e.g., wooden box) may help students reach the bar before they start the task.
- Students could be assessed in pairs. One student executes the pull-up and the partner counts the repetitions.

Protocol

1. **Start position:** With the palms of the hands facing out (overhand grip), grasp the overhead bar with arms straight and the rest of the body hanging vertically.
2. Start immediately, pulling body all the way up (so chin is even with the bar) and then extending all the way back down. This represents one repetition.
3. The score is the total number of pull-ups (repetitions) performed correctly without stopping.

Interpretation of Results

- The pull-up has been identified as a good indicator of upper body strength.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Modified Pull-Up

Purpose

- To assess upper body strength.

Target Group

- Recommended for students in Grade 4 and up or students with a physical disability.

Dependent Measure

- Total number of repetitions performed correctly without rest.

Required Equipment

- Elevated horizontal bar, with an elastic band/string hanging down 17.5 to 20 cm (7 to 8 in.) from the bar.

Administrative Suggestions

- Students could be assessed in pairs. One student executes the modified pull-up and the partner counts the repetitions.

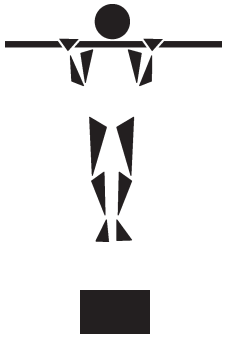
Protocol

1. **Start position:** Position the bar 2.5 to 5 cm (1 to 2 in.) above the outstretched hand of participant lying horizontal on the floor. With the palms of the hands facing out (overhand grip), grasp the overhead bar with arms straight, body straight, and heels touching the floor.
2. Pull up and touch the elastic band just below the chin and then return to the straight arm-hanging position. This represents one repetition.
3. The most important part of this task is to keep the body straight and use only the arms.
4. The score is the total number of modified pull-ups performed correctly without rest.
5. As upper body strength increases, the level of the bar can be raised.

Interpretation of Results

- The modified pull-up has been identified as a good indicator of upper body strength.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Flexed Arm-Hang



Purpose

- To assess upper body strength.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Time (minutes:seconds).

Required Equipment

- Elevated horizontal bar.

Administrative Suggestions

- Use of a platform (e.g., wooden box) may help students reach the bar before they start the task.
- Students could be assessed in pairs. One student executes the flexed arm-hang and the partner records the time.

Protocol

1. **Start position:** Grasp the bar with palms facing out (overhand grip) and with the chin placed at the same level as the bar while the rest of the body is hanging freely off the ground.
2. Hold this position for as long as possible.
3. The score is the total time the position can be held.

Interpretation of Results

- The flexed arm-hang is representative of isometric strength.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Curl-Up

Purpose

- To assess abdominal strength and endurance.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Total number of repetitions performed at a rhythmic pace.

Required Equipment

- Floor mat.
- Metronome (set to beep once every three seconds or 20 times per minute).

Administrative Suggestions

- Students could be assessed in pairs. One student executes the curl-up and the partner records the repetitions.

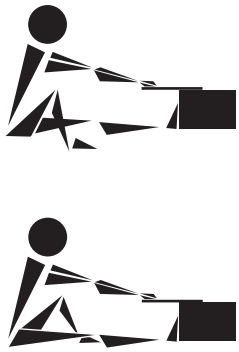
Protocol

1. Lie on back with knees flexed, feet flat on the mat, and heels between 30 cm (12 in.) and 45 cm (18 in.) from the buttocks.
2. Cross arms on chest with hands on the opposite shoulders.
3. The partner may hold the participant's feet down, applying only enough pressure to maintain feet contact with the floor.
4. Start on the command, "Ready…? Go."
5. Curl to a sitting position, maintaining hand contact with the shoulders. The curl-up is completed when the elbows touch the thighs.
6. Do not continue the motion beyond 45 degrees (angle between floor and straight back). Do not bounce.
7. Return to the down position until the back contacts the mat.
8. One complete curl-up (repetition) is counted when a cycle of down-up-down at the specified pace is completed.
9. Inability to keep pace with the "beeps" or to maintain the correct form on two consecutive repetitions indicates the assessment is over.
10. The score is the total number of curl-ups (repetitions) performed correctly without stopping to a maximum of 75.

Interpretation of Results

- The curl-up is representative of abdominal strength.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Modified Sit and Reach



Purpose

- To assess flexibility.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Maximum distance reached.

Required Equipment

- Flexometer. A sit-and-reach box can be made by placing a measuring stick on top of a box (approximately 30 cm or 12 in. high) so that the 23-cm or 9-in. mark is on the edge of the box facing the participant.

Administrative Suggestions

- Advise students that jerking, bouncing action is not allowed.
- Place the flexometer against a wall to prevent any movement in the apparatus during the procedure.
- Ensure that participants spend time warming up before performing this task.
- Advise students that the score is not counted if the knee of the extended leg bends.

Protocol

1. Take off shoes and sit with one leg fully extended. Place the sole of the foot flat against the back portion of the flexometer.
2. Flex (bend) the other leg, with the sole of the foot flat on the floor about 5 to 8 cm from inside of opposite leg.
3. Making sure hands are together (one atop the other, palms facing down), reach forward with arms evenly stretched, without jerking, and push along the measuring scale with the fingertips of both hands together.
4. Pushing as far forward as possible, hold this position for at least two seconds, and then return to the upright position.
5. Repeat the task three times and record the best score. Take the measurement to the nearest centimetre.
6. Repeat for the other leg.

Interpretation of Results

- The modified sit and reach is representative of flexibility.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Shoulder Stretch

Purpose

- To assess shoulder flexibility.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Expectation met or not met.

Required Equipment

- None.

Protocol

1. Stand with feet slightly apart and arms at the side. Bend knees slightly.
2. Raise one arm, bend it at the elbow, and reach down until the hand is between the shoulder blades of the upper back.
3. With the other arm bent at the elbow, reach behind the back and attempt to touch the fingertips of the other hand, which is down between the shoulder blades.
4. Attempt the same position again, but switch arms. (Most people are more flexible on one side than the other.)

Interpretation of Results

- A pass score is equivalent to touching the fingertips together behind the back.

Body Composition

Teaching Concepts Related to Body Composition

Address the following teaching concepts when administering fitness tasks related to body composition. Be sensitive to issues related to self-esteem, body size and weight, restricted or specialized diets, availability of or access to healthy foods, and home environments. Provide students with choice of activities and/or venues, where possible.

Definition

- **Body composition:** The relative amounts of muscle, bone, and fat in the body.

Physiology

Distinction between **weight** and **composition**:

- **Body weight** is misleading, as two individuals can have the same weight, and yet only one may be obese.
- **Body composition** refers to relative body fat (i.e., how much of an individual's body is lean tissue and how much is fat tissue).

Distinction between **overweight**, **over fat**, and **obesity**:

- While there is a definite relationship among the three terms, they cannot be used synonymously.
- **Overweight**
  - For adults, overweight is defined by a Body Mass Index (BMI) of 25 or more.
  - For children/youth, a BMI greater than the 85th percentile of Body Mass Index for Age charts is considered "at risk of overweight."
- **Over fat** means that an individual has more fat than he or she should have.
- **Obesity** is a medical disorder associated with being over fat.
  - For adults, obesity is defined by a BMI of 30 or more.
  - For children/youth, a BMI greater than the 95th percentile of Body Mass Index for Age charts is considered "obese."

Relationship of lean mass to body fat:

- Lean mass is found mostly in bones and muscles.
- Most fat is stored in adipose (fatty) tissue found beneath the skin and around body organs.
- Lean mass is denser and weighs more than fat.

Food imbalance:

- Weight gain or weight loss is caused when there is an imbalance of calories consumed and calories expended. For example, 0.45 kg (1 lb.) of body weight is approximately equal to 15,000 kilojoules (3500 calories).
- Calorie intake occurs through the food consumed and calorie expenditure occurs through activity performed.
- If calorie intake is greater then calorie expenditure, the body stores the excess as fat.

Training Guidelines

Methods of decreasing body fat:

- Reduce calorie intake (diet).
- Exercise (physical activity).
- Diet and exercise.

Weight reduction by combining diet and exercise:

- Calorie intake must be reduced more by diet alone than by combining diet and exercise. Weight loss through calorie reduction increases the chance of nutritional deficiency. Exercise prevents the loss of lean tissue. Therefore, there is little need to alter the diet. For example, by diet alone, weight loss is approximately 60% body fat and 40% lean mass. If exercise is included with the diet, the weight loss is almost 100% body fat. In weight reduction, the loss of body fat is desirable.

Benefits

- Many medical disorders (e.g., diabetes, heart disease) related to being over fat or under fat may be avoided by maintaining healthy body composition.
- Optimal levels of body fat enhance the quality of life.

Implications

Obesity in children and youth:

- **Obesity** is a state of being over fat. This condition is common in Canadian children/youth today.
- Obesity is associated with
  - low self-esteem
  - onset of diabetes
  - insulin disorders
  - cardiovascular diseases
  - increased resting heart rate
  - increased blood pressure
  - increased serum cholesterol levels
  - low levels of fitness

Eating disorders:

- **Anorexia nervosa** is an emotional eating disorder in which the individuals are obsessed with “thinness.” They will usually starve themselves until they suffer from malnutrition.
- **Bulimia** is an eating disorder characterized by recurring episodes of binge eating (i.e., the consumption of large amounts of food in short time periods). Other characteristics include attempts of severe diet restrictions, self-induced vomiting, and the use of diuretics.

Desirable levels of body fat:

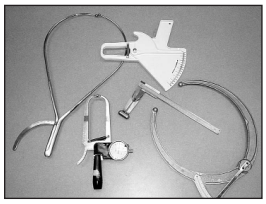
- To be able to assess their health and fitness, students need to be aware of the relationship between inactivity, physical fitness, and being over fat.
- Inform students of appropriate nutritional health practices and proper exercise habits to lose weight. Discourage them from participating in crash diets or unhealthy methods of weight reduction (e.g., caffeine and ephedrine combinations). Help them understand that such practices can contribute to depression, loss of self-esteem, eating disorders, or worse.
- When addressing body composition it is equally important to be aware of the individual who has a high amount of body fat (obesity) and the individual who has a dangerously low amount of body fat (anorexia or bulimia).

Fitness Assessment Task Options

The fitness assessment task options related to body composition are described on the following pages.

Fitness Component	Task Options
Body Composition	– Two-Site Skinfold – Four-Site Skinfold – Body Mass Index (BMI)

Two-Site and Four-Site Skinfold



Skinfold calipers

Purpose

- To measure the thickness of site-specific skinfolds using a skinfold caliper.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Skinfold (mm).

Required Equipment

- Skinfold calipers.

Administrative Suggestions

- Provide training in the use of skinfold calipers for volunteers who are administering the assessment task.
- Instruct participants to wear shorts and T-shirts to allow easy access to skinfold areas.
- If possible, set up more than one station.
- Ensure set-up allows for confidentiality.
- Measure participants separately.

Protocol

1. The following procedure standardizes the technique for the total skinfold measurements in both the two-site and four-site methods.
   a. Using the non-dominant hand, firmly grasp the skinfold between the thumb and forefinger. The lifted fold will include the underlying layer of fat.
   b. Place the contact surfaces of the skinfold calipers one centimetre (half an inch) below the finger, with the scale visible and the jaws of the caliper at a right angle to the body surface. The point on the fold where the reading should be taken is midway between the crest and the base of the skinfold.
   c. Close the caliper on the skinfold. Wait approximately two seconds for the indicator to stabilize and read the measurement to the nearest millimetre.
   d. Repeat the measurements (beginning at the first step) until three measurements are taken for each site. Record the median (middle) score for each site.

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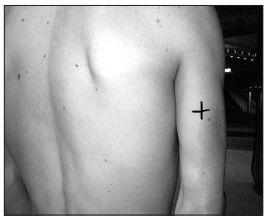
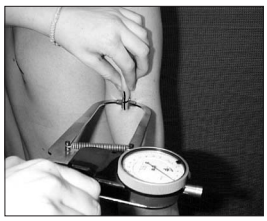
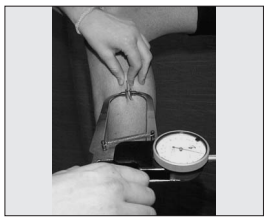
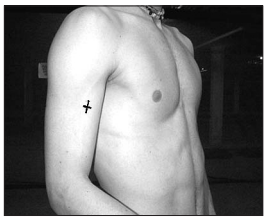
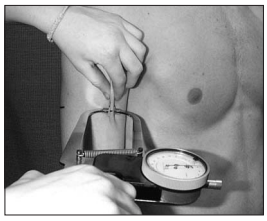
a. Triceps

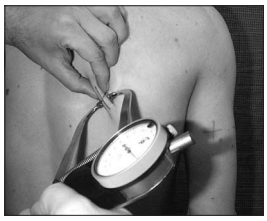
b. Calf

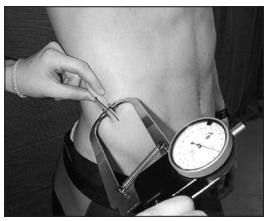
c. Biceps

d. Sub-scapular

e. Supra-iliac

2. The subcutaneous fat measurement sites and measurement techniques are described below.
   a. **Triceps:** Measure the triceps halfway down the right arm between the tip of the acromion and top of the radius, with the fold picked up in a line passing directly up the arm from the tip of the olecranon process. The arms hang relaxed at the side.
   b. **Calf:** Have the participant place the right foot on a bench with the knee slightly flexed when taking the calf measurement. Measure the calf on the inside of the right lower leg at the largest part of the calf girth. With the thumb and index finger, grasp and gently lift up the skin slightly above the level of the largest part of the calf so that the caliper can be placed at the level of the largest part of the calf.
   c. **Biceps:** Lift the skinfold on the front surface of the right upper arm over the prominence and middle of the biceps muscle. The participant's arm should hang relaxed. Lift the skinfold parallel to the long axis of the humerus.
   d. **Sub-scapular:** The skinfold is located just below the angle of the right scapular, the fold being picked up parallel to the natural cleavage line of the skin.
   e. **Supra-iliac:** The skinfold is located immediately above the crest of the right ilium. Lift the fold at a slight angle to the vertical.

3. Summation of skinfold measurement methods:
   - **Two-site method:** Add the median (middle of the three scores) for triceps to the median of the calf scores to obtain a final sum.
   - **Four-site method:** Add the median of the three scores for triceps, biceps, sub-scapular, and sub-iliac to find the sum of the skinfold measurements.

Interpretation of Results

- A formula is used to calculate percentage of body fat using skinfold measurements.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

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Body Mass Index (BMI)

Purpose

- This task indicates a student's weight relative to his or her height.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measures

- Height (m).
- Weight (kg).

Required Equipment

- Tape measure (metric).
- Scale (metric).

Administrative Suggestions

- Due to the sensitivity of body mass (weight) measures, make every effort to preserve the confidentiality of results.
- Have students weigh themselves in a personal setting.

Protocol

1. Measure height.
2. Measure body mass (weight).

Interpretation of Results

- To calculate Body Mass Index, insert height (m) and weight (kg) measures into the formula: kg/m^2. Schools/divisions/districts find BMI measurement to be of lesser concern to parents than skinfold measurement, even though the latter is a more accurate indicator of body composition.
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Cardiovascular Endurance

Teaching Concepts Related to Cardiovascular Endurance

Address the following teaching concepts when administering fitness tasks related to cardiovascular endurance.

Definitions

- **Cardiovascular endurance:** Represents the combined ability of
  - the pulmonary system to exchange oxygen between the outside air and the blood circulating through capillaries in the lung
  - the cardiovascular system to transport oxygen to the working muscles
  - the muscular system to use oxygen
- Other terms used to describe this component of health-related physical fitness include
  - cardiorespiratory endurance
  - cardiorespiratory fitness
  - cardiovascular fitness
  - aerobic fitness
  - aerobic power
  - aerobic capacity
  - physical work capacity

  For all practical purposes, these terms can be used interchangeably.

Physiology

Physiology concepts:

- The body requires oxygen to produce energy (adenosine triphosphate [ATP]) during aerobic activity.
- Oxygen requirements increase as activity intensity increases.
- Oxygen requirements and heart rate increase as activity levels increase.
- The cardiovascular system (heart, blood, veins, arteries, lungs) carries food and oxygen to the working muscles and carries wastes away from the working muscles.

Training Guidelines

Overload:

- Exercise should be sufficiently intense to raise the pulse high enough (intensity 60% to 85% heart rate [HR] maximum) and sustain it long enough (duration 15 to 60 minutes) to get a training effect.
- The following formula is recommended for calculating target heart rate:

  Step 1: 220 – age = HR maximum

  Step 2: HRmax – HRrest = Trainable HR

  Step 3: (Trainable HR x 0.6) + HRrest = Lower Value

  Step 4: (Trainable HR x 0.85) + HRrest = Upper Value

  Step 5: Target HR Range (THRR) = Lower to Upper Values

Note: It is not necessary to calculate THRR for Early Years students. Encourage children to move, run, and play.

- The purpose of calculating target heart rate is to help students develop a proper pace instead of focusing on competition. Other methods of calculating target heart rate are available.

Specificity:

- Select exercises that will raise heart rate for a continuous period of time. These exercises include jogging, skating, swimming, cycling, dancing, Nordic skiing, and so on.
- Alternatively, select sports such as basketball, orienteering, lacrosse, soccer, racquet sports, ringette, and so on.

Progression:

- Perform a continuous rhythmic activity.
- Increase time gradually, from 15 to 20 minutes.
- Increase rate gradually. Run 1600 m in 7:45 instead of 8:00 minutes.
- Increase distance gradually. For example, cover four kilometres instead of three.
- Increase frequency from three days per week to five days per week.

Regularity:

- To develop and maintain cardiovascular endurance, follow an overload program of continuous activity at least three to five days per week throughout life.
- If training activities are discontinued, improved cardiovascular function begins to deteriorate.

Benefits

Cardiovascular endurance:

- The benefits of improved cardiovascular endurance include
  - decreased resting heart rate (RHR)
  - increased stroke volume (SV)
  - increased maximum heart rate (MHR)
  - decreased heart rate at sub-maximal workloads
  - decreased recovery time following exercise
  - decreased serum cholesterol levels
  - increased metabolic rate during and after exercise sessions
  - decreased total body fat
  - decreased blood pressure

Implications

Risk factors:

- **Risk factors** are conditions or habits that can increase the chance of developing heart disease.
- The greater the number of risk factors, the greater the chances are of contracting heart disease. Risk factors are cumulative.

Categories of risk factors:

- Uncontrollable
  - sex
  - age
  - heredity
- Controllable
  - high blood pressure
  - serum cholesterol
  - stress
  - diabetes
  - obesity
  - physical activity
  - smoking

To modify risk factors:

- Participate in activities that are enjoyable.
- Attempt to modify one risk factor at a time.
- Keep in mind that everyone has some risk factors. Be aware of the uncontrollable risk factors and modify the controllable ones.

Medical disorders:

- Screen participants of prolonged physical activity for medical disorders.
- Become acquainted with the disorders, their symptoms, and emergency procedures in the event the students experience difficulty.

Fitness Assessment Task Options

The fitness assessment task options related to cardiovascular endurance are described on the following pages.

Fitness Component	Task Options
Cardiovascular Endurance	– 1600-Metre Run/Walk – 1600-Metre Walk – Léger's 20-Metre Shuttle Run (Also known as Beep-Test, PACER Test)

1600-Metre Run/Walk

Purpose

- To run/walk 1600 metres (1 mile) in the shortest possible time.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measures

- Time (minutes:seconds).
- Body Mass Index ($kg \cdot m^{-2}$).

Required Equipment

- Measured track or course. A level, circular 400-m track is the recommended venue; however, a suitable substitute may be created in an open field area using pylons.
- Timing device (e.g., stop watch).

Administrative Suggestions

- Reinforce the importance of pacing during a run or walk and making an honest personal effort. If possible, address the concept of pacing. Have students practise pacing over 1600 m before the day of assessment.
- Organize participants into pairs. Participant A counts the number of laps and records the finish time for participant B, and vice versa.
- When the runners finish the distance, the instructor calls out the time, while the runners' partners record the time.

Protocol

1. Do a warm-up exercise to prepare for the task.
2. Start on the command, "Ready…? Go."
3. Run 1600 m as fast as possible using an even pace. (If participants cannot complete the distance by running, then walking is permitted.)
4. Record the finish time to the nearest second.
5. Do a cool-down exercise by walking for three to five minutes.

Interpretation of Results

- Results can be used to predict VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$) using the equation established by Cureton, Sloniger, O'Bannon, Black, and McCormack (1995). The equation is based on a sample of 753 males and females, 8 to 25 years of age, and uses age (years), gender (coded F=0, M=1), Body Mass Index (BMI in units of $kg \cdot m^{-2}$), and run time (minutes) for the prediction.
- $VO_2max = 0.21 (Age \times Gender) - 0.84 (BMI) - 8.41 (Time) + 0.34 (Time^2) + 108.94$
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

1600-Metre Walk

Purpose

- To walk 1600 m in the shortest possible time while maintaining a constant walking pace the entire distance.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Time (minutes:seconds).
- Heart rate (beats per minute) at completion of task.

Required Equipment

- Measured track or course. A level, circular 400-m track is the recommended venue; however, a suitable substitute may be created in an open field area using pylons.
- Timing device (e.g., stop watch).

Administrative Suggestions

- Reinforce the importance of pacing a walk and making an honest personal effort. If possible, address the concept of pacing. Have students practise pacing over 1600 m before the day of assessment.
- Organize participants into pairs. Participant A counts the number of laps and records the finish time for participant B, and vice versa.
- When the walkers finish the distance, the instructor calls out the time, while the walker's partner records the time.

Protocol

1. Do a warm-up exercise to prepare for the assessment task.
2. Start on the command, "Ready…? Go."
3. Walk 1600 m as fast as possible using an even pace.
4. Take heart rate immediately after completing the task.
5. Record the finish time to the nearest second.
6. Do a cool-down exercise by walking for three to five minutes.

Interpretation of Results

- Results can be used to predict VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$) using the equation established by Kline, Porcari, Hintermeister, Freedson, Ward, McCarron, Ross, and Rippe (1987). The equation is based on a sample of 343 men and women, 30 to 69 years of age, and uses age (years), gender (coded F=0, M=1), weight (lb.), walk time (minutes), and heart rate (bpm) at the end of the walk for the prediction. McSwegin, Plowman, Wolff, and Guttenberg (1998) demonstrated the validity of this equation for high school-age individuals.
- VO_2max = 6.315(Gender) – 0.3877(Age) – 0.0769(Weight) – 3.2649(Time) – 0.1565(bpm) + 132.853
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).

Léger's 20-Metre Shuttle Run

Purpose

- To run as long as possible, back and forth across a 20-m distance, at a specified pace that gets faster each minute.

Target Group

- Recommended for students in Grade 4 and up.

Dependent Measure

- Total number of lengths and students' age.

Required Equipment

- Measured 20-m course. Most school gymnasiums are appropriate; however, a hard outdoor surface may also be used.
- Two markers (cones/tape).
- Pre-recorded CD that plays music for pacing.

Administrative Suggestions

- Reinforce the importance of making an honest personal effort.
- Organize participants into pairs. Participant A records the finish time for participant B, and vice versa.
- Measure the 20-m distance and mark it clearly with cones/tape.

Protocol

1. Do a warm-up by running and stretching before the start of the task.
2. Listen carefully to the music and the instructions.
3. The CD will emit a single beep at various intervals. Try to be at the opposite end of the 20-m course by the time the next beep sounds. After each minute, the time interval between beeps decreases and running speed has to increase correspondingly.
4. Place one foot on or behind the 20-m mark at the sound of each beep. Students who do not reach the line at the sound of the beep receive a warning that they will be eliminated if they are not at the opposite end of the 20-m course at the sound of the next beep.
5. When near exhaustion, students falling short of the 20-m line twice in succession have their task terminated and their score recorded.
6. After completing the task, cool down by walking, followed by stretching.

Interpretation of Results

- Results can be used to predict VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$) using the equation established by Léger, Mercier, Gadoury, and Lambert (1988). The equation is based on a sample of 188 boys and girls, 8 to 19 years of age. The equation uses the highest speed (km/h) attained on the task, age (yr.), and the speed x age interaction for the prediction.
- VO_2max = 0.1536 (Max Speed x Age) – 3.238 (Max Speed) – 3.248 (Age) + 31.025
- For information related to criterion-referenced standards, please refer to *FITNESSGRAM® Test Kit* (The Cooper Institute for Aerobics Research, 1999).