The Chinese University of Hong Kong
Physical Education Unit
Required/ Elective Physical Education Course – Physical Conditioning

(I) Definition of Physical Fitness

Physical fitness is defined as a set of attributes that people have or achieve that relate to the ability to perform physical activity. Being physically fit has been defined as "the ability to carry out daily tasks with vigour and alertness without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies" (Caspersen et al., 1985).

(II) Classification of Physical Fitness

1. Health-related physical fitness
    a. Aim: Healthy body and high quality of life.
    b. Components: Cardiorespiratory endurance; muscular strength; muscular endurance; flexibility; body composition.
2. Sports-related physical fitness
    a. Aim: Specificity of training toward a particular goal.
    b. Components: Agility; balance; reaction time; speed; power; coordination.

(III) Definition of Health-Related Physical Fitness & Sports-Related Physical Fitness

Health-related physical fitness

1. Cardiorespiratory endurance
   Cardiorespiratory endurance refers to the ability of the circulatory and respiratory systems to transport oxygen and nutrients to working muscles efficiently. It also refers to the ability to do prolong exercise by the whole body.
2. Muscular strength
   Muscular strength refers to the maximum force exerted by a muscle group.
3. Muscular endurance
   Muscular endurance refers to the ability of a muscle group can sustain a static muscular contraction or contract repeatedly within a period. It also refers to the ability of the muscular system can work efficiently.
4. Flexibility
   Flexibility refers to the ability of various joints to effectively perform an optimal range of motion. Factors affecting flexibility include genetics, the bone and joint structure, muscular tension, muscular strength, ligaments, etc.
5. Body composition
   Body composition refers to the percentages of body fat and lean body mass.

Sports-related physical fitness

1. Agility
   Agility refers to the ability to change the position of the body in space with speed and accuracy.
2. Balance
   Balance refers to the maintenance of equilibrium while stationary or moving.
3. Reaction time
   Reaction time refers to the time elapsed between stimulation and the beginning of the reaction to it.
4. Speed
   Speed refers to the ability to perform a movement within a short period of time.
5. Power
   Power refers to the ability or rate at which one can perform work.
6. Coordination
   Coordination refers to the ability to use the senses, such as sight and hearing, together with body parts in performing tasks smoothly and accurately.

(IV) <u>Physical Fitness Training Procedures</u>

1. Warm-up phase (approximately 5 - 10 minutes)
   a. Start by doing some low-intensity exercises such as jogging, running in place, indoor biking, etc., to raise heart rate and muscle temperature.
   b. Follow by 3 - 8 minutes of mobility exercises and stretching to help reduce chances of injury and improve motor ability
      - Stretch each major muscle group slowly until the tight position.
      - Hold each movement for 15 to 30 seconds.
      - Please refer to appendix 1 or the e-booklet of skill-related stretching: https://www.peu.cuhk.edu.hk/en-gb/pe-courses/online-pe-learning-resources/stretching
   c. High intensity dynamic stretching exercises such as high knees, heel flicks, jumping jacks, lateral slides, etc.,

2. Conditioning phase (approximately 20 - 60 minutes)
   a. Aerobic fitness (cardiorespiratory endurance conditioning)
      - Any rhythmical, repeatable and aerobic exercise that uses large muscle groups and can be maintained for a prolonged period, e.g. walking, jogging, rope skipping, cycling or rowing.
      - The exercise intensity can be represented by using the 10-point Rate of Perceived Exertion Scale (RPE). The training effect is significant if you feel hard to very hard (4 - 7) during the exercise.

0	2	4	6	9	10
Not at all	Little exertion	Hard	Very Hard	Very Very Hard	Exhausted

      - Measure heart rate periodically to adjust exercise intensity to meet the recommended level, i.e. target heart rate.
        Formula: (220 - age) x 60% = _____bpm (lower limit)

(220 - age) x 90% = _____bpm (upper limit)

*bpm = beats per minute

- 20 to 60 minutes of the above aerobic exercise is recommended to gain aerobic fitness.
- Exercise 3 - 5 times a week on alternate days is recommended.

b. Muscular strength and endurance training (approximately 20 - 60 minutes)
   - The weight selection and adjustment depend on the training objectives.
   - Muscular endurance: low resistance, high repetitions or sustaining a static muscular contraction
   - Muscular hypertrophy: medium resistance, medium repetitions.
   - Muscular strength: high resistance, low repetitions.
   - Muscular power: high resistance, low repetitions.
   - 1 repetition maximum (RM): the maximum load that the muscle groups can lift for a particular exercise. The larger value of the RM, the lighter the exercise load.

Training Objectives	Sets	Repetition Maximum (RM)	Intensity (% of 1RM)	Rest between sets
Muscular Power	3-5	1 – 5	85 – 100	3 - 5 minutes
Muscular Strength	3 - 5	4 – 6	85 – 90	3 - 5 minutes
Muscle Hypertrophy	3 - 5	8 – 12	67 – 80	2 - 3 minutes
Muscular Endurance	2 - 3	> 15	< 65	1 - 2 minutes

3. Cool-down phase (approximately 5 - 10 minutes)
   a. After the conditioning phase, keep exercising at a lower intensity for cooling down and excreting metabolic wastes.
   b. Do static stretching as in the warm-up phase, or use foam rollers, and massage balls to reduce delayed muscle onset soreness.
   c. Prevent blood pooling: When you suddenly stop the exercise without cool down procedures may cause your heart rate to drop abruptly, blood may pool in your working muscles instead of circulating back to the heart, and further, dizziness and fainting. In some severe cases, it may lead to cardiac arrhythmia, which is a life-threatening condition.

Please refer to appendix 2 or the guidelines of resistant training:
https://www.peu.cuhk.edu.hk/images/content/pe-courses/fitness-guidelines.pdf

(V) Training Principles

1. Progressive overload: The training effect is significant when the exercise exceeds a level greater than accustomed to induce adaptation.
2. Reversibility: Once cardiorespiratory training is decreased or stopped for a significant period (2 – 4 weeks), previous improvements will reverse and decrease, and the body will readjust to the demands of the reduced physiological stimuli. Resistance training should be performed regularly several times per week to make continual gains in muscular fitness.

3. Individual differences: All individuals will not respond similarly to a given training stimulus. For example, individuals may respond differently to the same resistance training program for muscular strength.
4. Specificity of training: Specific exercise elicits specific adaptations, creating specific training effects. For example, running would be the appropriate mode to select, as activities such as cycling or swimming do not train the specific muscles and movement patterns needed to complete a half-marathon. Only muscle groups that are trained will make desired adaptations in selected parameters of muscular fitness. Exercises such as the squat and leg press can be used to enhance lower body strength, but these exercises will not affect upper body strength.

(VI) <u>Selected Guidelines for Resistant Training</u>

1. Range of motion: Range of motion should be considered when performing the resistance training exercise. Restriction in the range of motion for a prolonged period can result in shortening of the muscle and limited joint movement.
2. Keep breathing: During resistance training, the breathing rhythm of exhaling while against resistance (concentric contraction) with 1 - 2 seconds and inhaling while on the return (eccentric contraction) with 2 - 4 seconds should be performed*.
3. Balanced muscle development: the flexor and extensor of muscle groups should be trained equally, e.g. sit-up (abdominal flexion) and back arch (hyper-extension).

***concentric contraction:** A type of muscle contraction in which the muscles shorten while generating force.

eccentric contraction: A type of muscle contraction in which the muscles lengthen while generating force.

isometric contraction: **A** type of muscle contraction without motion.

(VII) <u>Circuit Training</u>

Circuit training is the combination of 8 - 12 exercises with short rest periods between them that can improve both cardiorespiratory and muscular fitness. The number of cycles and repetitions for each exercise is prescribed and the exercises are completed cycle by cycle. The stations may include muscular strength, muscular endurance, and aerobic exercises.

1. Selection of stations: The stations include the training of the major muscle groups according to the training target.
2. The number of repetitions in a set of each station should be checked by the ability testing.
3. The order of the stations: Similar muscle groups should be arranged further apart in the cycle to prevent overloading the same muscle group and losing the training effect.

An example of circuit weight training for muscle toning (2 - 3 sets, 8 - 12 RM):

(VIII) Interval Training

Interval training is a training session arranging the exercise and rest alternatively instead of continuously. This method is good for stimulating the cardiorespiratory system. Some training principles are as follows:

1. Firstly, decide which energy system wants to be trained.
   a) ATP-PC system; b) lactic acid system; c) aerobic system.
2. Decide the type of rest.
   a. Passive rest: suitable for the sprinting or long-distance interval training;
   b. Active rest: suitable for the medium high-speed type of interval training.
3. The exercise and rest ratio within a set for a different type of interval training.
   a. ATP-PC system 1:12 - 20 (10 seconds for 50 meters, rest for 2 - 3 minutes)
   b. Lactic acid system 1:3 - 5 (1’30” for 400 meters, rest for 4’30” - 7’30”)
   c. Aerobic system 1:0.5 (10 minutes for 2000 meters, rest for 5 minutes)

After finishing a set of training, in general, rest should be taken until the heart rate goes back to about 60% of the maximum heart rate, and the next set can be started.

Training examples:

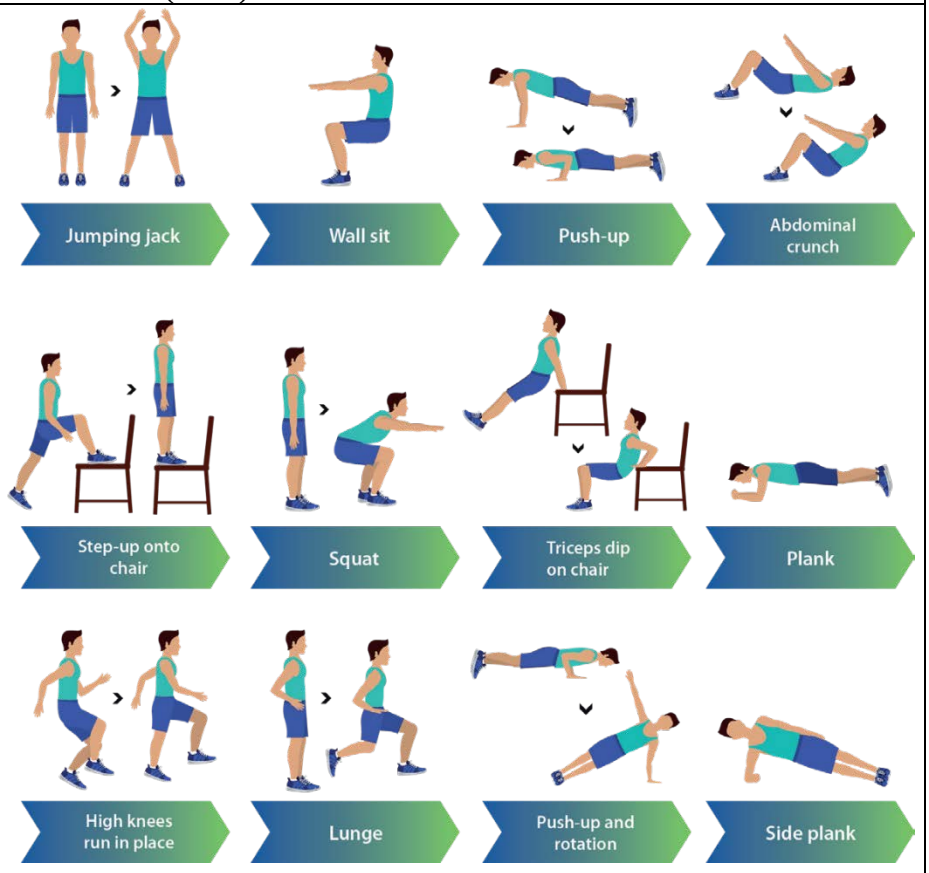
	Distance		Times/set		Number of sets		Total distance	System trained
a)	50m	×	6	×	3	=	900m	ATP-PC system
b)	400m	×	4	×	2	=	3200m	Lactic acid system
c)	2000m	×	3	×	1	=	6000m	Aerobic system

(IX) <u>High-Intensity Interval Training (HIIT) or High-Intensity Circuit Training (HICT)</u>

HIIT or HICT is the training with exercise and rests arranged alternatively, the maximum heart rate during exercise can be reached 90% or more. Training can be done anywhere with or without training equipment. Exercise difficulties or exercise time can be easily adjusted according to the individual's ability. For example, you may design your HIIT programme with each exercise for 30 seconds and rest for 15 seconds. A 3-set programme can be finished within 30 minutes. This training can improve both anaerobic and aerobic endurance systems concurrently, in the sense that not only the exercise can burn fat and build or sustain muscle fitness effectively, but also increase the metabolic rate after exercise.

Recommended HIIT exercise by Kilka & Jordan (2013)

1. Jumping jack (whole-body)
2. Wall sit (lower body)
3. Push-up (upper body)
4. Abdominal crunch (Core)
5. Step up onto chair (whole-body)
6. Squat (lower body)
7. Triceps dip on chair (upper body)
8. Plank (core)
9. High knees/ run in place (whole-body)
10. Lunge (lower body)
11. Push-up and rotation (upper body)
12. Side plank (core)



(X) Exercise Prescription (FITT)

Prescription / Goal	Cardiorespiratory Endurance⌖	Burn Fat+	Muscular Strength△	Muscular Endurance △	Flexibility
Frequency (F)	3 - 5 days/week	≥ 5 days/week	2 - 3 days/week	2 - 3 days/week	2 - 3 times/week
Exercise Intensity (I)	Moderate: 60% of HRmax^ Vigorous: 90% of HRmax^	Initial: 40% - 60% of HRmax^ Progression: ≥ 60% of HRmax	1 RM#: Beginner: 40% - 50% Intermidaite: 60-80% Experienced: ≥ 80% 8 - 12 repetitions 2 - 4 sets rest intervals: 2 - 3 minutes	< 50% 1 RM 15 - 20 repetitions 2 - 4 sets rest intervals: 2 - 3 minutes	Stretch to the point of feeling tightness or slight discomfort
Time (T)	Moderate: 30 - 60 minute/day Vigorous: 20 - 60 minute/day	30 - 60 minutes	No specific duration		Static/ Dynamic: 10 - 30 seconds PNF: 3 - 6 seconds light-to-moderate contraction followed by 10 - 30 seconds assisted stretch 2 - 4 sets No specific duration
Type of Exercise (T)	Walk, jog, cycle, row, swim, water aerobic activity etc.	Aerobic physical activity, resistance training, flexibility	Multiple-joint exercises Train agonist and antagonist muscle groups Different types of equipment Bodyweight exercises		Static stretching, Dynamic stretching or PNF etc.

^HRmax = 220 - age

⌖Table and norm of 1-mile walk test for cardiorespiratory endurance (Appendix 3)

+Skinfold measurements (Appendix 4)

△Record form for muscular strength and endurance (Appendix 5)

#Training load chart (Appendix 6)

(XI) <u>Physical Activity Pyramid</u>

In the Physical Activity Pyramid (Corbin & Pangrazi, 1998), there are 6 types of physical activities which are classified into 4 levels:

Level 1: Lifestyle Physical Activity

The activities in this level which is low to moderate intensity should be done most to reduce the risk of overweight/obesity and chronic diseases.

Level 2：Active Aerobics & Active Sports and Recreation

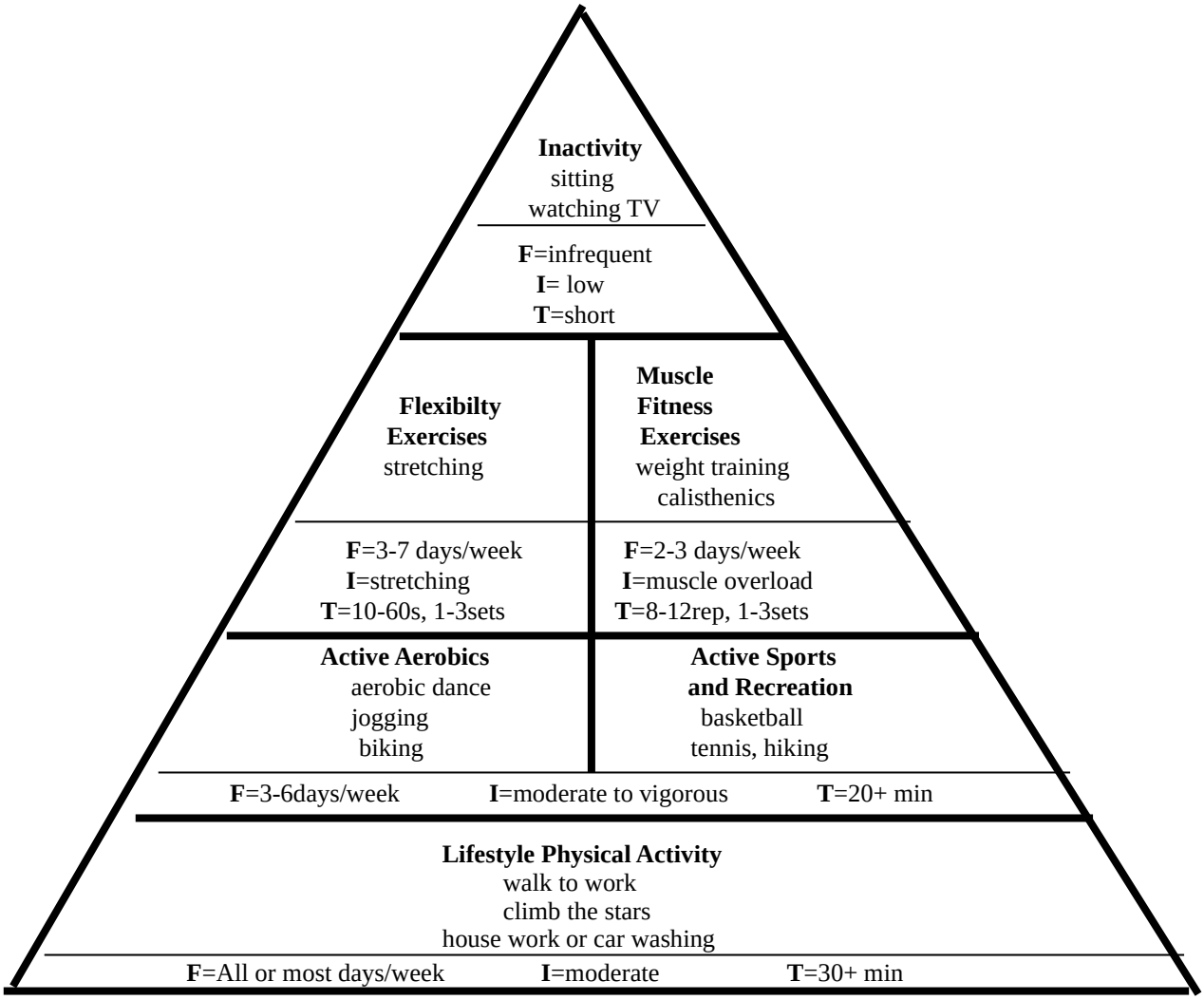
The activities in this level which is moderate to vigorous intensity should be done more to improve the cardiorespiratory endurance so that health and the ability to carry out daily tasks can also be improved.

Level 3: Flexibility Exercises & Muscle Fitness Exercises

The activities in this level should be done in the appropriate amount to effectively prevent back pain and body postural problems.

Level 4: Inactivity

Sedentary behaviour at this level should be kept minimal. The effects of sedentary behaviour include excessive fatigue, feeling tiredness and boredom, which would further impair your bodily functioning.



(XII) Canadian 24-hour movement guidelines for adults

For health benefits, adults aged 18-64 years should be physically active each day, minimize sedentary behaviours, and achieve sufficient sleep.

Physical activity:	Moderate to vigorous aerobic physical activities such that there is an accumulation of at least 150 minutes per week; muscle-strengthening activities using major muscle groups at least twice a week; several hours of light physical activities, including standing.
Sleep:	Getting 7 - 9 hours of good-quality sleep regularly, with consistent bed and wake-up times.
Sedentary behaviours:	Limiting sedentary time to 8 hours or less, which includes no more than 3 hours of recreational screen time, and breaking up long periods of sitting as often as possible.

(XIII) <u>Safety Precautions for Exercise</u>

1. If you have the following disease, please consult your doctor before exercising:

Heart Disease	Hypertension
Diabetes	Liver Disease

2. Wear proper sports clothes and sports shoes.
3. If you are a beginner, please work with a partner.
4. Make sure that the selector key is fully inserted and locked before you lift weights by yourself.
5. Keep your back straight and exhale while lifting weight.
6. Please keep clear of moving parts at all times
7. If weights are jammed, please inform the attendants and do not attempt to free the weights by yourself.
8. Please put all free weights back in their place when you finished.
9. Before working with new equipment, read the instructions carefully so that safety and training effects can be obtained.
10. No eating drinking, or running inside the fitness room
11. Stop immediately if the following symptoms exist: Dizziness; chest pain; continuous soreness of a certain muscle/ joint; nausea; abnormal breathing.

References / Websites

Alter M. J. (2004). Science of Flexibility. Champaign, IL: Human Kinetics.

American College of Sports Medicine. (2022). American College of Sports Medicine. https://www.acsm.org/

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126-131.

Centers for Disease Control and Prevention. (1999). Physical Activity and Health: A Report of the Surgeon General. https://www.cdc.gov/nccdphp/sgr/index.htm

Centers for Disease Control and Prevention. (2022). Physical Activity Basics. https://www.cdc.gov/physicalactivity/basics/index.htm

Corbin, C. B., & Pangrazi, R. P. (1998). Physical activity pyramid rebuffs peak experience. *ACSM's Health & Fitness Journal, 2*(1), 12-17.

Exercise is Medicine (2022). Exercise is Medicine. https://www.exerciseismedicine.org/

Klika, B., & Jordan, C. (2013). High-intensity circuit training using body weight: Maximum results with minimal investment. *ACSM's Health & Fitness Journal, 17*(3), 8-13.

Liguori, G., American College of Sports Medicine. (2021). ACSM's Guidelines for Exercise Testing and Prescription. Philadelphia, PA: Wolters Kluwer.

Physical Education Unit, The Chinese University of Hong Kong. (2016). Guidelines for Resistance Training. http://www.peu.cuhk.edu.hk/images/content/pe-courses/fitness-guidelines.pdf

Physical Education Unit, The Chinese University of Hong Kong. (2024). E-booklet of Skill-related Stretching. http://www.peu.cuhk.edu.hk/zh-tw/pe-courses/stretching

Physical Fitness Association of Hong Kong, China. (2024). Physical Fitness Association of Hong Kong, China. http://www.hkpfa.org.hk/index/customIndex.aspx?nnnid=1

U.S. Department of Health and Human Services (2024). Healthy People 2030. https://health.gov/healthypeople

王怡璇（譯）（2010）。《運動解剖書》（原作者：P., Manocchia）。台灣：木馬文化（原作出版年：2009）

中國香港體適能總會（2017）。《器械健體導師手冊》。香港：中國香港體適能總會。

中國香港體適能總會（2017）。《體適能導師綜合理論》。香港：中國香港體適能總會。

阮伯仁，沈劍威（2006）。《體適能基礎理論》（第二版）。香港：中國香港體適能總會。

林正常（2002）。《運動科學與訓練》。台灣：銀禾文化事業有限公司。

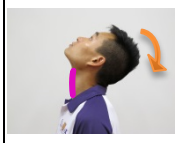
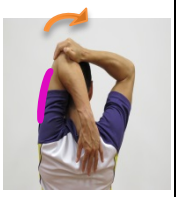
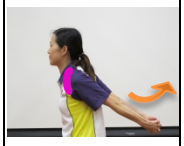
許世全（2015）。《實用體適能測試與評估》。香港：陳湘記圖書有限公司。

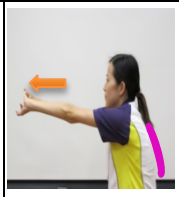
許育達，陳壹豪，應充明，鄭明昇（譯）（2014）。《核心訓練圖解聖經》（原作者：Dorling Kindersley Ltd）。台灣：旗標科技股份有限公司。（原作出版年：2013）

鄭景峰、吳柏翰、王鶴森、何仁育（譯）（2015）。《基礎全人健康與體適能》（原作者：A. L., Thygerson, S. M., Thygerson）。台灣：藝軒圖書文具有限公司。（原作出版年：2012）

(Appendix 1)

Examples of Stretching Exercise

Stretched muscle groups	Descriptions	Diagram	Key points
1. Neck extensor	Let the head move downward naturally.		Relax the back muscles of the neck.
2. Neck flexor	Move the head up naturally.		Relax the muscle groups around the neck and the throat.
3. Sideward neck flexor	Move the head sideways slowly and naturally.		Relax the lateral muscles of the neck which are being stretched.
4. Deltoid	• Put the arm (need to be stretched) straight in the front and then the other arm press the forearm towards the chest.		• Stretch the straight elbow as far as possible towards the other side of the shoulder. • When the deltoid (shoulder) feels like being stretched, hold for 15 seconds.
5. Triceps	• Raise the arm (need to be stretched) and bend the elbow with the palm on the upper back. • Another hand pulls the elbow toward the back neck until the triceps feel stretched.		• Relax the bent elbow. • Avoid over-stretching the elbow toward the back neck.
6. Pectoralis major	• Clasp your hands behind your back. • Lift your arms, with your back straight and put your chest forward.		• During the process, the elbow should keep straight. • During the process, maintain regular breathing.
7. Abdominals	• Stand with a one-foot step slightly backwards. • Two arms pull upward as far as possible or a little bit bending backwards.		• The whole body stretches upward as much as possible. • During the process, maintain regular breathing.

Stretched muscle groups	Descriptions	Diagram	Key points
8. Sideward flexor & latissimus dorsi	• Stand with your feet about shoulder-width apart. • One arm keeps straight and bends the whole body together toward another side. Another hand can be put on the thigh of the bent leg.		• The stretching arm should keep as straight as possible. • The leg can be bent a little bit with the tiptoes pointing to the side. • Bend your body until the waist muscles feel like being stretched.
9. Upper back muscle groups	• Straighten your arms out in front of you. Clasp your fingers together with the palms facing outward. • Stretch as far as possible at shoulder level.		• Two shoulders will pull a little bit forward. • Maintain regular breathing. • Relax the upper back muscles.
10. Lower back muscle groups	• Stand with your feet about shoulder-width apart. • Kneel and pull the chest towards the thighs tightly. • Two palms pull as far as possible to reach the ground.		• When kneeling, keep the soles on the ground. • The chest should lean as closely as possible towards the thighs. • Two hands should stretch forward as far as possible. • If you find it difficult to balance while kneeling, you can do the above actions by using your calf as support. You can even sit on the bench to do the same actions.
11. Gluteus maximus	• Sit with the left leg straight while the right leg bent at 90° and crossed over the left leg. • Turn your waist to the right and put your right hand on your right-back position to support, the left elbow placed outside the right (bent) knee. Pull your right knee gently until the hip muscles feel stretched. • Hold 15-30 seconds and repeat with the other leg.		• Use your left elbow to push the right knee towards the hip. Hold for about 15 - 30 seconds when you feel stretched. • Relax the hip muscles.

Stretched muscle groups	Descriptions	Diagram	Key points
12. Quadriceps	• Stand up and use your right hand to hold the front of your right foot. • The knee of the bending leg should be on the back of the knee of the supporting leg. • When finished, repeat with the other leg.		• You can hold a rail for support while doing this exercise. • Beware to use the same hand to hold the same leg. • The knee of the bending leg should be on the back of that of the supporting leg. • The ankle of the bending leg should not touch the hip.
13. Hamstrings	• Sit on a bench with one leg straight and the other leg bent stepping on the ground. • Lean the upper body forward, and with your hands attempt to touch your toes. Continue until you feel a gentle stretch in the back of your thighs. • When finished, repeat with the other leg.		• Keep your straight leg as straight as possible. • The waist should keep straight stretching forward.
14. Thigh adductors	• Stand with your feet about shoulder-width apart. • One leg bends at about 90°, while another leg keeps straight. • Your body weight should be put onto the bent leg. • Continue to press down until a gentle stretch is felt on the thigh adductors.		• When bending the knee, keep another leg straight, the knees should facing forward, while the inner thigh (adductor) muscles facing down. • The knee of the bent leg should not exceed the tiptoe position. Otherwise, the bent leg should step a little forward to ensure it is in the appropriate position.
15. Gastrocnemius (Calf)	• Stand with your feet together, then step back with one foot. • Bend your front leg at about 90°, while the leg behind keeps straight. The rear foot should face forwards with the heel on the floor.		• Stand with your feet about shoulder-width apart. • The knee of the front leg should not be beyond the tiptoes. • Keep your heels on the floor with the tiptoes pointing forward. • Pressing the hip downward can increase the degree of stretching.

(Appendix 2)

Resistance Training Demonstration

Movement	**Picture**	**Core muscular groups**
Shoulder press	 	Trapezius, deltoid
Leg press/ seated leg extension	 	Quadriceps
Seated abdominal crunch	 	Abdominal muscle
Biceps curl	 	Biceps
Seated leg curl	 	Hamstrings
Chest press	 	Pectoralis major
Knee raise	 	Abdominal muscle
Back extension	 	Erector spinae, gluteus maximus
Tricep pushdown	 	Triceps
Lat pull down	 	Latissimus dorsi

(Appendix 3)

1 mile (1609m) Walking Test (Kline et al.,1987)

Lap Counting Sheet

Name: Body weight: (lb.)

Age: Gender: Testing date:

1	2	3	4

Requirements for the walk:

1. steady speed for the whole walk
2. post-exercise HR ≧115 bpm

Record: walk time = _____.____(minutes) (in 2 decimal places)

Post exercise heart rate (15 second x 4) = _____bpm

$VO_{2\ max}$ =

132.853 - (0.0769 x BW【lb.】) - (0.3877 x Age【year】) + (6.3150 x gender*) - (3.2649 x time【minutes】) - (0.1565 x post-exercise heart rate)

*Men = 1, Women = 0

$VO_{2\ max}$ (ml/min/kg) - Cardiorespiratory Endurance Index

Age	Poor	Low Ave.	Average	Good	Excellent
Women					
20-29	≦ 33	34-35	36-43	44-50	≧51
30-39	≦ 30	31-33	34-41	42-47	≧48
40-49	≦ 29	30-32	33-39	40-45	≧46
50-59	≦ 26	27-29	30-37	38-43	≧44
60-69	≦ 22	23-26	27-34	35-40	≧41
Men					
20-29	≦ 34	35-37	38-47	48-52	≧53
30-39	≦ 32	33-35	36-45	46-49	≧50
40-49	≦ 31	32-34	35-43	44-47	≧48
50-59	≦ 29	30-32	33-41	42-45	≧46
60-69	≦ 26	27-29	30-36	37-41	≧42

Reference

Department of Sports Science and Physical Education, The Chinese University of Hong Kong (2013). H*ealthy Exercise for All Campaign - Physical Fitness Test for the Community*. Hong Kong: Leisure and Cultural Services Department.

1 mile (1609m) Running Test (George et al.,1993)
Lap Counting Sheet

Name: Body weight: (kg)
Age: Gender: Testing date:

1	2	3	4

Requirements for the run:
1. steady speed for the whole run
2. post-exercise HR ≧120 bpm

Record: walk time = _____.____(minutes) (in 2 decimal places)
Post exercise heart rate (15 second x 4) = _____bpm

Men's $VO_{2\ max}$ = 108.844 - (0.1636 x BW【kg】) - (1.438 x time【minutes】) - (0.1928 x post-exercise heart rate)

Women's $VO_{2\ max}$ = 100.5 - (0.1636 x BW【kg】) - (1.438 x time【minutes】) - (0.1928 x post-exercise heart rate)

$VO_{2\ max}$ (ml/min/kg) - Cardiorespiratory Endurance Index

Age	Poor	Low Ave.	Average	Good	Excellent
Women					
20 - 29	≤ 33	34 - 35	36 - 43	44 - 50	≥ 51
30 - 39	≤ 30	31 - 33	34 - 41	42 - 47	≥ 48
40 - 49	≤ 29	30 - 32	33 - 39	40 - 45	≥ 46
50 - 59	≤ 26	27 - 29	30 - 37	38 - 43	≥ 44
60 - 69	≤ 22	23 - 26	27 - 34	35 - 40	≥ 41
Men					
20 - 29	≤ 34	35 - 37	38 - 47	48 - 52	≥ 53
30 - 39	≤ 32	33 - 35	36 - 45	46 - 49	≥ 50
40 - 49	≤ 31	32 - 34	35 - 43	44 - 47	≥ 48
50 - 59	≤ 29	30 - 32	33 - 41	42 - 45	≥ 46
60 - 69	≤ 26	27 - 29	30 - 36	37 - 41	≥ 42

Reference

Department of Sports Science and Physical Education, The Chinese University of Hong Kong (2013). H*ealthy Exercise for All Campaign - Physical Fitness Test for the Community*. Hong Kong: Leisure and Cultural Services Department.

(Appendix 4)

Tanita Body Composition Analyzer

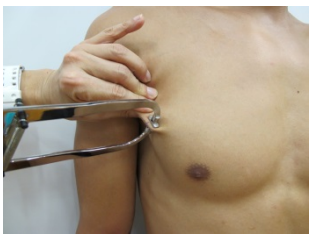
Tanita Body Composition Monitors calculate your body composition using Bioelectrical Impedance Analysis (BIA). Safe, low-level electrical signals are passed through the body via the patented Tanita foot pads on the monitor platform.
Please refer to the user guide for further instructions:
https://tanita.eu/media/pdf/products-tanita/professional/MC-780/MC-780MA%20N%20Instruction%20Manual%20%28EN%29%202018%20%282%29.pdf

Skinfold Test

Objective: Measure the body composition (body fat percentage)
Equipment: skinfold calliper, soft meter rule, pen
Procedures:

1. All the measurements are on the right side of the body.
   Men: Chest, abdominal and thigh;
   Women: Triceps, suprailiac, and thigh.
2. The tester uses the left thumb and forefinger to grasp the correct skinfold position of the subject (make sure that no muscle is grasped) and then the calliper is applied by the right hand 1 cm below the finger which grasped the correct skinfold position. The depth of the grasp should be half of the total thickness of the fold. The fingers holding the calliper should be relaxed and held for 2 seconds until the reading is stable. Record the reading.
3. Repeat the above procedures. If the two readings are within 2 mm, it will be acceptable and the mean will be recorded as the final reading of that site. Otherwise, the third time or the fourth time should be measured until any two of the readings are acceptable so that the final reading can be recorded.
4. Sum up the 3 skinfold site readings and find out the relative percentage fat from the table in the appendix below and add up the percentage fat find from the adjusted age table. It becomes the final percentage of body fat.
5. Referring to the norm table of the percentage of body fat according to age, the category of body fatness can be found and the interpretation can be made.
6. Skinfold Sites:

[Chest] Diagonal fold is taken between axilla and nipple as high as possible on the anterior axillary fold, with the measurement taken 1 cm below fingers.
[Abdominal] Vertical fold is taken 3 cm at the right side of the centre of the umbilicus.
[Thigh] Vertical (midline) fold is lifted on the anterior aspect of the thigh midway between the inguinal crease and proximal border of the patella. Bodyweight is shifted to left foot and calliper is applied 1 cm below fingers.
[Suprailiac] Oblique fold is grasped posteriorly to the midaxillary line and superiorly to the iliac crest along natural cleavage of skin with calliper applied 1 cm below fingers.
[Triceps] Vertical (midline) fold is lifted on the posterior aspect of the arm midway between the acromial process and olecranon process and calliper is applied 1 cm below fingers.

	[Chest]	[Abdominal]	[Thigh]
Men			
W	[Suprailiac]	[Triceps]	[Thigh]

Percentage fat prediction from the sum of skinfolds for men and women with adjusted age

Skinfold Thickness	Men % Fat	Women % Fat	Age	Men	Women
13 - 17	1.1	6.2	**17 - 19**	2.1	1.1
18 - 22	2.7	8.1	**20 - 22**	2.4	1.3
23 - 27	4.2	9.9	**23 - 25**	2.8	1.5
28 - 32	5.8	11.9	**26 - 28**	3.1	1.7
33 - 37	7.3	13.7	**29 - 31**	3.5	1.9
38 - 42	8.8	15.5	**32 - 34**	3.8	2.1
43 - 47	10.3	17.2	**35 - 37**	4.2	2.3
48 - 52	11.7	18.9	**38 - 40**	4.5	2.4
53 - 57	13.2	20.6	**41 - 43**	4.9	2.6
58 - 62	14.5	22.3	**44 - 46**	5.2	2.8
63 - 67	15.9	23.9	**47 - 49**	5.6	2.9
68 - 72	17.3	25.4	**50 - 52**	5.9	3.2
73 - 77	18.6	26.9	**53 - 55**	6.3	3.4
78 - 82	19.9	28.4	**56 - 58**	6.6	3.6
83 - 87	21.1	29.8	**59 - 61**	6.9	3.8
88 - 92	22.4	31.2	**62 - 64**	7.3	3.9
93 - 97	23.6	32.5	The sum of % fat (from the sum of skinfold) and % fat (from adjusted age) = % body fat		
98 - 102	24.7	33.8			
103 - 107	25.9	35.1			
108 - 112	26.9	36.2			
113 - 117	28.1	37.4			
118 - 122	29.1	38.5			
123 - 127	30.1	39.5			
128 - 132	31.1	40.5			

Norm of percentage body fat

Standard of body fat	Age Groups			
	<30	**30-39**	**40-49**	**> 49**
	Men			
Too High	> 28	> 29	> 30	> 31
High Average	22 - 28	23 - 29	24 - 30	25 - 31
Average	11 - 21	12 - 22	13 - 23	14 - 24
Low Average	6 - 10	7 - 11	8 - 12	9 - 13
Too Low	> 6	< 7	< 8	< 9
	Women			
Too High	> 32	> 33	> 34	> 35
High Average	26 - 32	27 - 33	28 - 34	29 - 35
Average	15 - 25	16 - 26	17 - 27	18 - 28
Low Average	12 - 14	13 - 15	14 - 16	15 - 17
Too Low	< 12	< 13	< 14	< 15

(Appendix 5)

Personal Training Log

Exercise Log

Date:____________ (M Tu W Th F Sa Su)					Readiness*: 1 2 3 4 5				Weight:______________	
EXERCISES	1RM	SETS	REPS	WT	REST	TIME	DIST	HR	INT**	NOTES

Date:____________ (M Tu W Th F Sa Su)					Readiness*: 1 2 3 4 5				Weight:______________	
EXERCISES	1RM	SETS	REPS	WT	REST	TIME	DIST	HR	INT*	NOTES

Date:____________ (M Tu W Th F Sa Su)					Readiness*: 1 2 3 4 5				Weight:______________	
EXERCISES	1RM	SETS	REPS	WT	REST	TIME	DIST	HR	INT*	NOTES

Date:____________ (M Tu W Th F Sa Su)					Readiness*: 1 2 3 4 5				Weight:______________	
EXERCISES	1RM	SETS	REPS	WT	REST	TIME	DIST	HR	INT*	NOTES

*Readiness for exercise: 1-Very Poor; 2-Poor; 3-Average; 4-Good; 5-Very Good

**INTENSITY: E/M/H = Easy/Medium/Hard

(Appendix 6)

Estimating 1 RM and training loads

MAX REPS (RM)	1	2	3	4	5	6	7	8	9	10	12	15
%1RM	100	95	93	90	87	85	83	80	77	75	67	65
Load (pounds or kilograms)	10	10	9	9	9	9	8	8	8	8	7	7
	20	19	19	18	17	17	17	16	15	15	13	13
	30	29	28	27	26	26	25	24	23	23	20	20
	40	38	37	36	35	34	33	32	31	30	27	26
	50	48	47	45	44	43	42	40	39	38	34	33
	60	57	56	54	52	51	50	48	46	45	40	39
	70	67	65	63	61	60	58	56	54	53	47	46
	80	76	74	72	70	68	66	64	62	60	54	52
	90	86	84	81	78	77	75	72	69	68	60	59
	100	95	93	90	87	85	83	80	77	75	67	65
	110	105	102	99	96	94	91	88	85	83	74	72
	120	114	112	108	104	102	100	96	92	90	80	78
	130	124	121	117	113	111	108	104	100	98	87	85
	140	133	130	126	122	119	116	112	108	105	94	91
	150	143	140	135	131	128	125	120	116	113	101	98
	160	152	149	144	139	136	133	128	123	120	107	104
	170	162	158	153	148	145	141	136	131	128	114	111
	180	171	167	162	157	153	149	144	139	135	121	117
	190	181	177	171	165	162	158	152	146	143	127	124
	200	190	186	180	174	170	166	160	154	150	134	130
	210	200	195	189	183	179	174	168	162	158	141	137
	220	209	205	198	191	187	183	176	169	165	147	143
	230	219	214	207	200	196	191	184	177	173	154	150
	240	228	223	216	209	204	199	192	185	180	161	156
	250	238	233	225	218	213	208	200	193	188	168	163
	260	247	242	234	226	221	206	208	200	195	174	169
	270	257	251	243	235	230	224	216	208	203	181	176
	280	266	260	252	244	238	232	224	216	210	188	182
	290	276	270	261	252	247	241	232	223	218	194	189
	300	285	279	270	261	255	249	240	231	225	201	195
	310	295	288	279	270	264	257	248	239	233	208	202
	320	304	298	288	278	272	266	256	246	240	214	208
	330	314	307	297	287	281	274	264	254	248	221	215
	340	323	316	306	296	289	282	272	262	255	228	221
	350	333	326	315	305	298	291	280	270	263	235	228
	360	342	335	324	313	306	299	288	277	270	241	234
	370	352	344	333	322	315	307	296	285	278	248	241

MAX REPS (RM)	1	2	3	4	5	6	7	8	9	10	12	15
%1RM	100	95	93	90	87	85	83	80	77	75	67	65
	380	361	353	342	331	323	315	304	293	285	255	247
	390	371	363	351	339	332	324	312	300	293	261	254
	400	380	372	360	348	340	332	320	308	300	268	260
	410	390	381	369	357	349	340	328	316	308	274	267
	420	399	391	378	365	357	349	336	323	315	281	273
	430	409	400	387	374	366	357	344	331	323	288	280
	440	418	409	396	383	374	365	352	339	330	295	286
	450	428	419	405	392	383	374	360	347	338	302	293
	460	437	428	414	400	391	382	368	354	345	308	299
	470	447	437	423	409	400	390	376	362	353	315	306
	480	456	446	432	418	408	398	384	370	360	322	312
	490	466	456	441	426	417	407	392	377	368	328	319
	500	475	465	450	435	425	415	400	385	375	335	325
	510	485	474	459	444	434	423	408	393	383	342	332
	520	494	484	468	452	442	432	416	400	390	348	338
	530	504	493	477	461	451	440	424	408	398	355	345
	540	513	502	486	470	459	448	432	416	405	362	351
	550	523	512	495	479	468	457	440	424	413	369	358
	560	532	521	504	487	476	465	448	431	420	375	364
	570	542	530	513	496	485	473	456	439	428	382	371
	580	551	539	522	505	493	481	464	447	435	389	377
	590	561	549	531	513	502	490	472	454	443	395	384
	600	570	558	540	522	510	498	480	462	450	402	390

Example:
An athlete's 10 RM = 300 pounds
Estimated 1 RM = 400 pounds

Reference

Haff, G. G., & Triplett, N. T. (2015). *Essentials of Strength Training and Conditioning*. Human Kinetics.