

Science in Coaching

INTRODUCTION

GymSports New Zealand's coaching philosophy is to develop coaches to be athlete-centred within coaching practice. At the outset, it is important to understand that the key to the athlete-centred approach is a leadership style that caters to athletes' needs and understandings where athletes are enabled to learn, become aware and have control of their participation in sport. Some of the main advantages of using an athlete-centred approach to coaching are that athletes are motivated to learn and they have a greater understanding and stronger retention of both tactics and skills (cognitive, emotional, social and physical), which are so important to success in sport. An athlete centred coach facilitates learning but does not control it. This approach is clearly beneficial given that athletes must be self-sufficient in their performance, decision making and option taking while competing in their respective gym sport. In particular, an athlete-centred approach encourages athletes to become self-aware and self-sufficient, encourages athlete ownership and responsibility, allows them to make informed decisions and emphasises individual growth and change.

The purpose of this module is to assist coaches to understand and apply sport science principles that benefit athlete performance and enjoyment. Coaching is both a science and an art. This module assists coaches understanding of the sciences and their application in an integrated way during training sessions.

PHYSICAL CONDITIONING

Physical conditioning is the process of preparing the body appropriately for the physical demands required by the gym sport. Having the body's energy systems, muscle groups, joints, ligaments, tendons and organs etc. responsible for effective functioning in appropriate condition, will result in the individual being capable of improved levels of performance and deriving greater enjoyment from participation.

- Screening

The great advantage of having a screening system prior to engaging in demanding physical activity is that it gives the coach information about any past or existing injuries or other conditions that deserve consideration to develop training programmes for the individual.

- Specificity

An important consideration for coaches is the notion of the specificity of preparation and fitness for sport. Each gym sport makes its own unique demands on the human body therefore requiring preparation that is specific to the demands being made. There is very little value in spending hours running distances slowly, or even engaging in skills at low intensity, if the nature of participation in competition demands short bursts of activity at a very high intensity. For this reason coaches should examine very closely the pattern of activity demanded of athletes in competition.

By determining the level of activity; duration of intermittent activity spells; inactive periods; muscle groups involved; range of motion; demands in terms of components of fitness such as strength and explosive power, the coach can then work out the type of training that will prepare the body for the specific demands of the sport.

With regard to younger athletes in particular, much of the physical preparation can be done making use of sport specific game situations. This means that the physical preparation can be closely linked to the movement preparation. That is, the physical demands can be placed on the body while developing skills specific to the sport.

■ Training loads

As athletes progress from childhood through to adulthood, so do their bodies progress from a stage of immaturity through to fully developed muscle groups, joints and organs. Coaches need to be mindful therefore that they “load” bodies appropriately during training sessions. The human body is capable of meeting physical challenges and the body benefits from being extended appropriately. It is important that coaches take the trouble to know where their athletes are in terms of physical readiness for the demands of competition. With this knowledge in mind, they can construct training sessions that are appropriate to both the demands of the gym sport and the readiness of their athletes. In this way coaches construct optimal challenges for their athletes in that each individual is required to extend themselves just that little bit further as he or she reaches out to a new level of performance. Equally important is that the challenge is one that is well understood by the athlete who derives enjoyment from taking on a challenge that is meaningful and specific to the gym sport. In this way, athletes derive satisfaction from participation and gain enjoyment from the physical demands made of them within the sport environment.

NUTRITION

NUTRITIONAL GUIDELINES FOR HEALTH

Healthy nutrition benefits any competitive athlete regardless of age, gender or level of competition. Research reveals that sprint, endurance and strength skills, for example, all benefit from the food that the athlete consumes. Good nutrition will not only benefit competition day. It will quite possibly make the athlete feel and train better and hence is an important consideration for effective day-to-day activity and training. The guidelines that follow are designed to ensure that athletes understand the correct proportions of foods to suit both training and everyday needs.

BASIC GUIDELINES

The points that follow meet the New Zealand guidelines for healthy eating and can be adjusted to suit an athlete's specific sports needs.

■ Eat a variety of food

Eating a variety of food from all the major food groups will give your body all the nutrients it requires.

- 6-11 serves of bread/cereal/rice/pasta – This will give carbohydrates for energy, dietary fibre and a number of vitamins and minerals
- 5+ a day of fruits and vegetables – This will give a boost in vitamins and minerals as well as dietary fibre and carbohydrates.
- 2-3 serves of meat/meat alternatives, dairy/dairy alternatives – This provides our body with protein for building and repair muscles, as well as providing a source for many vitamins (fat soluble) and minerals such as iron.
- Eat minimal amounts of fats/oils and sugar – Although our bodies use fat for insulation and protection, too much can cause fat build up which leads to medical conditions such as, heart disease, cancer and obesity.

■ Eat dietary fibre

Dietary fibre is found in cereals, grains, wholemeal breads, fruits and vegetables. Dietary fibre regulates intestinal function and improves bowel health.

■ Limit total fat intake

Fat is classified as saturated or unsaturated and most foods offer a mixture of both. Saturated fat increases total blood cholesterol, particularly Low Density Lipoproteins (LDL) which promotes build-up on the artery walls, causing heart disease. Saturated fats are found in animal products. To reduce the amount of saturated fat, trim visible fat off meat and choose low fat dairy products. Unsaturated fats are mainly found in plant based products. They are classified as polyunsaturated and provide omega-6 and omega-3 or monounsaturated fat, which has been found to help decrease LDL cholesterol.

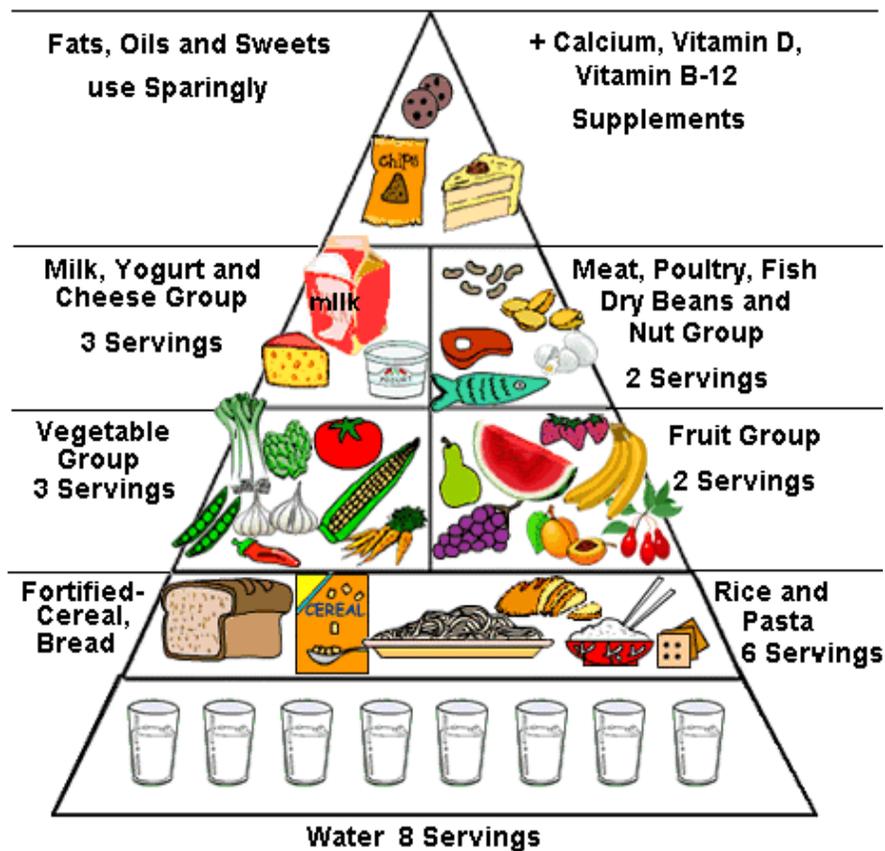
■ Limit sodium and food high in salt

High sodium intake is associated with high blood pressure. Most processed foods contain salt so there is no need to add extra salt to food.

■ **Maintain fluid intake**

6-8 glasses of water a day are required and on days when athletes are engaging in physical activity, at least 2-4 extra glasses are needed. Sugary drinks or drinks high in caffeine should be avoided during exercise as these sorts of drinks are not effective at re-hydrating the body.

THE HEALTHY FOOD PYRAMID



NUTRITION FOR GYMNASTS

Eating well at all times is essential for good health and top performance. Athletes have large energy needs and to meet this they need to eat more than just three meals a day. Snacks are an essential part of an athletes diet and these should be chosen well.

■ **Carbohydrates (CHO) -**

CHO is the number one energy food for the body. This is the fuel for the engine. Gymnasts need plenty of energy for muscles, the brain and growing. CHO is used in the body as glucose and is stored in muscles as glycogen. The brain must have glucose for it to work properly and muscles need glycogen for action. If CHO intake is low, glycogen levels will be low and the gymnast will quickly run out of energy during exercise resulting in fatigue.

■ **Proteins**

Proteins are needed for growth and muscle building. Most young gymnasts will still be growing and have a higher need for protein than adults. However the average New Zealand diet provides more than enough protein - extra protein is not usually needed.

■ **Fats**

Fats are a concentrated source of energy, which gives taste, texture and satisfaction to a meal. Fats also supply fat-soluble vitamins and essential fatty acids. Too much fat should be avoided as it can have a detrimental effect on health and often is used instead of the all important CHO. Fat should not be left out of the diet. 25 - 30% of the energy should come from fat.

■ **Vitamins**

Vitamins are only needed in small amounts. It is most unlikely that someone eating sufficient energy from a wide variety of foods will be lacking in vitamins. Taking extra vitamins will not enhance performance - there is usually no need to take vitamin supplements. Vitamins do not supply energy but are catalysts in the energy systems. They are also antioxidants which destroy harmful free radicals produced in the body.

■ **Minerals**

Like vitamins these are only needed in small amounts in the diet and in most cases the required amount is easily obtained. There are many minerals which the body needs for health, but there are two which may cause concern: iron and calcium.

Iron is needed as part of the oxygen transport system in the blood and if lacking less oxygen is transported to the muscles, which leads to a lack of energy and tiredness. The best source of iron is red meat.

Calcium is essential for bone growth and strength. Growing teenagers have very high needs for calcium. The best source of calcium is milk and dairy foods. The recommended intake is about 3 servings per day.

NUTRITION FOR TRAINING & COMPETITION

CHO needs are high for gymnasts—most need 6-8gCHO/kg body weight. For a 45kg gymnast this means a CHO intake of 270—360g. This is above the intake of many adults but is necessary to ensure the gymnast has the energy levels to sustain training.

For most gymnasts eating a high CHO intake will mean increasing the amount of food eaten and increasing the number of meals eaten. Eating less fatty foods will make more room for CHO in the diet. Eating more often and choosing snacks well will also increase CHO intake.

Eating well at all times is essential for good health and top performance. Athletes need to eat prior to training—the timing will vary from person to person but eating 1-2 hours before activity suits most people. This gives time for food to empty from the stomach before exercise.

- Eating a protein food such as a milk drink just prior to a gym workout may well improve muscle development.
- Eating after exercise is very important for replacing muscle glycogen (energy).

COMPETITION NUTRITION

Over the course of a competition a gymnast's fuel and fluids need to be replaced regularly. Successful nutritional management during a competition involves planning and preparation.

- Good nutrition during training and days before the competition will ensure the body has built up good energy stores to sustain performance throughout the competition.
- A good supply of light, easily digested and familiar foods is essential. Always use foods which have been tried and are liked. Practice different foods, food combinations and timing in training to find the things that work best for you.

SUMMARY

While athletes can pay careful attention to a refined diet that will benefit performance, the first priority is to have a thorough understanding of basic healthy eating habits that ensure that the body is appropriately nourished on a day to day basis. This brief guide serves to provide coaches with a fundamental understanding of healthy nutrition. It is hoped that the application of this knowledge will benefit athletes in any population who might be eating poorly and thus jeopardising both their health and sports performance.

EXAMPLES OF AVERAGE SERVE SIZES

Vegetables

- 1 medium potato, kumera, yam or taro (135g)
- ½ cup cooked vegetables e.g. puha, water cress, parengo or corn (50-80g)
- ½ cup salad or mixed vegetables (60g)
- 1 tomato

Fruits

- 1 apple, pear, or orange (130g)
- 2 small apricots or plums (100g)
- ½ cup fresh fruit salad or stewed fruit (canned, frozen or fresh) (135g)
- 1 cup fruit juice or a serving of dried fruit (only one counts)

Carbohydrate Group: Breads and cereals

- 1 bread roll (50g)
- 1 muffin (80g)
- 1 medium slice rewena
- 1 medium slice bread (26g)
- 1 cup cornflakes
- ½ cup of muesli
- ½ cup of cooked porridge
- 1 cup cooked pasta or rice (150g)
- 1 cup cassava or tapioca (150g)
- 2 plain sweet biscuits (14g)

Protein Group: Milk and milk products

- 1 large glass of milk (250mL)
- 1 pottle yoghurt (150g)
- 2 slices of cheese (40g)
- 2 scoops of ice-cream (140g)

Protein Group: Lean meat, chicken, seafood, eggs, cooked dried beans, peas, lentils

- 2 slices cooked meat (100g)
- ¾ cup mince or casserole (195g)
- 1 egg (50g)
- 1 medium fillet of fish cooked (100g)
- 1 medium steak (120g)
- ¾ cup of dried cooked beans (135g)
- 2 drumsticks or 1 chicken leg (110g)

REFERENCES

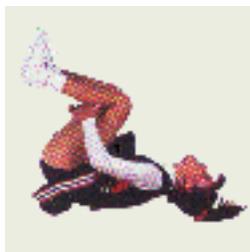
- Inge, Karen (2001). Sports Nutrition, in Frank S. Pyke (Ed.). *Better Coaching – Advanced Coach's Manual* (pp. 181-189). Human Kinetics: Lower Mitcham.
- NZ Academy of Sport Nutrition Fact Sheet (Carbohydrate)
- NZ Academy of Sport Nutrition Fact Sheet (Protein)

BIOMECHANICS

Coaches aim to assist their athletes to improve their sporting competency and so achieve their performance goals. An understanding of biomechanical principles along with in-depth sport specific knowledge is needed to achieve these outcomes. Hay has defined biomechanics as “the science concerned with the internal and external forces acting on a human body and the effects produced by these forces.” (Hay 1993, p.2). The following is a summary of the biomechanical principles involved in gym sports skills:

<p>1. Apply forces in the direction you want an object to travel.</p>	
<p>2. Position body to effectively produce ground reaction force (action-reaction).</p>	
<p>3. Generate necessary ground reaction forces by using large muscle groups.</p>	
<p>4. Use appropriate combination of force and timing to produce the desired change in motion.</p>	

<p>5. Reduce the impact forces by maximizing the time taken to change the motion</p>	
<p>6. In activities involving projecting the human body or other objects, use a large number of joints in sequence from large to small (segment sequencing).</p>	
<p>7. Select appropriate velocity of release, angle of release and height of release to produce the desired result.</p>	
<p>8. In activities in which the human body is projected, performance may be enhanced by redistributing the mass of the body about the centre of gravity.</p>	

<p>9. Stability is increased by increasing the area of the base of support, moving the centre of gravity towards an expected perturbing force and lowering the centre of gravity.</p>	
<p>10. To produce rotation, apply the force away from the axis of rotation.</p>	
<p>11. Increase the rate of rotation by redistributing the mass of the body close to the axis of rotation.</p>	
<p>12. Optimise release velocity of an object by a suitable combination of rate of rotation and distance of the object from the axis of rotation.</p>	

BIOMECHANICAL PRINCIPLES AND GYMSPORTS

The correct application of biomechanical principles to the Fundamental Movement Patterns is necessary if athletes are to successfully acquire more advanced skills.

STATICS

- Centre of Gravity (COG) over base of support to balance
- If not leads to rotation
- Stability greater if larger base of support
- Body Alignment important

LANDINGS

- Controlled descent

- Increase time and space for greater absorption of force
- Correct posture important
- 'Safety proof' athletes with landing training

SPRING

- Explosive punch rather than a slower jump
- Body tension important

SWING

- Ascent shorten radius, descent lengthen
- Body position and tension important

ROTATION

- Smaller radius = faster rotation

MOVEMENT ANALYSIS

It is important to develop the ability to observe human movement in a sports context in a systematic way and understand that there are different phases within any given movement. Within each phase of a specific movement, there are key components of the movement and specific biomechanical principles that apply. It is important that a coach has the ability to analyse movement using these principles. Of equal importance is what the coach decides to do with the knowledge acquired from such an analysis. The modern approach to coaching encourages athletes to perform skills in a way that suits them as individuals. Coaches should encourage athletes to arrive at their own movement solutions as far as possible without allowing the athlete to be compromised in terms of safety at any stage. The coach should therefore not overload the athlete with excessive technical information. Information derived from the analysis of movement might provide key insights for well phrased questions that the coach will put to the athlete. This information can be vital in assisting the athlete towards the level of movement proficiency that the athlete is striving for.

ASSIGNMENT

For this assessment a coaching journal should be used to record results and answer discussion questions.

1. Have one or more athlete/s complete the **Athlete Exercise Screening Questionnaire** attached and complete the following questions in your journal:
 - After completion of the questionnaire and fitness test, evaluate athletes' present physical state relative to the physical demands needed for your sport. Pay special attention to any specific conditions pertaining to the individual athlete, e.g. recurring injuries.
 - Write up a summary of each athlete's fitness level in your coaching journal.

2. With the information gained from the **Exercise Screening Questionnaire**, design activities for a training session including a sport specific warm up for your gym sport. Justify in your journal the warm up activities you have selected.
- Conduct the session (before conducting the session, ensure that your athletes understand the physical conditioning objectives for the session) and on completion discuss with the athletes and record response in the coaching journal:
 - A) Their experience of the warm up.
 - B) What went well in the session as a whole and what didn't.
 - C) If the session achieved the physical goals set.
 - D) If the session attended to individual athletes' (who filled out the **exercise screening questionnaire**) physical weaknesses.
 - E) How the session might have been improved to better achieve the physical goals set for the group as a whole and the athletes individually.
3. List 5 skills in your gym sport that you consider to be important.
- Make use of the table below to take **two** of the listed skills and identify the phases that you would divide the skill into for the purpose of analysing performance of the skill.
 - Using the table, list the key elements of technique in each phase that you would be looking for and identify the biomechanical principles underlying each key element.

Skill:		
Phase	Key elements	Biomechanical principles
Eg. Bowling run-up	Gradual acceleration Rhythm Balanced – arms tucked in	Apply forces in direction you want object to travel Generate forces – large muscle groups

- Use the table below to briefly describe four important observation considerations you have in mind when analysing the skills listed above, either in practice or during competition.

OBSERVATION CONSIDERATIONS	
Consideration	Comment
Eg. Angle of observation	When watching the bowling action remember to make use of front, back and right-angle side on observation positions

- Make use of the table below to identify possible reasons for the skills listed above being poorly performed by any of the three athletes.

Eg. Skill: Bowler strays down the leg side	
Sub-discipline	Possible performance error
Technical	Drops head and falls towards the offside
Physical	Overweight, tires quickly and fails to follow through
Psychological	Becomes angry, forces delivery, drops arm
Tactical	Batsman has weakness on leg side so wants to minimise run scoring opportunities.
Skill:	
Sub-discipline	Possible performance error

4. Have one or more athlete/s complete the **Daily Food Intake Template** attached and complete the following analysis in your journal:
- On the template what food groups have been consumed the most.
 - What areas are neglected and need improving?
 - What strategies could be introduced to improve food consumption in the identified neglected areas?
 - Discuss the content and volume of the fluid intake. Make a note of any aspects that are unacceptable and suggest ways to improve these areas.

GLOSSARY

It is important for you to have an understanding of basic anatomical terms. This makes it easier to discuss and provide effective descriptions of human movement. Terms which are commonly used to describe movements of the body, and direction or location in relation to the standard anatomical position, are defined below.

Term	Definition
abduction	movement away from the midline of the body
adduction	movement towards the midline of the body
anterior	towards the front of the body
circumduction	movement of a limb where the hand or foot traces a circle
depression	movement of a body part downwards
distal	further from the trunk
dorsi flexion	movement of the foot at the ankle to raise the toes and foot towards the tibia
elevation	movement of a body part upwards
eversion	rotation of the foot to turn the sole of the foot outwards
extension	movement causing an increase in the angle at a joint
flexion	movement causing a decrease in the angle at a joint
frontal plane	divides the body into anterior and posterior sections; or front and back halves
horizontal plane	divides the body into superior and inferior sections; or upper and lower halves
hyperextension	extension of joint beyond its normal range of movement
inferior	towards the feet
inversion	rotation of the foot to turn the sole of the foot inwards
lateral	away from the midline of the body
medial	towards the midline of the body
plantar flexion	movement of the foot at the ankle to point the toes
posterior	towards the rear of the body
pronation i.e. palms	movement of the forearm so that the radius and ulna are crossed; down or backwards
proximal	closer to the site of attachment or beginning of a body part
rotation	movement about an axis of the body, either medially (inward) or laterally (outward)
sagittal plane	divides the body into right and left halves
superior	towards the head
supination	movement of the forearm so that the radius and ulna are parallel, i.e. palms up or forwards

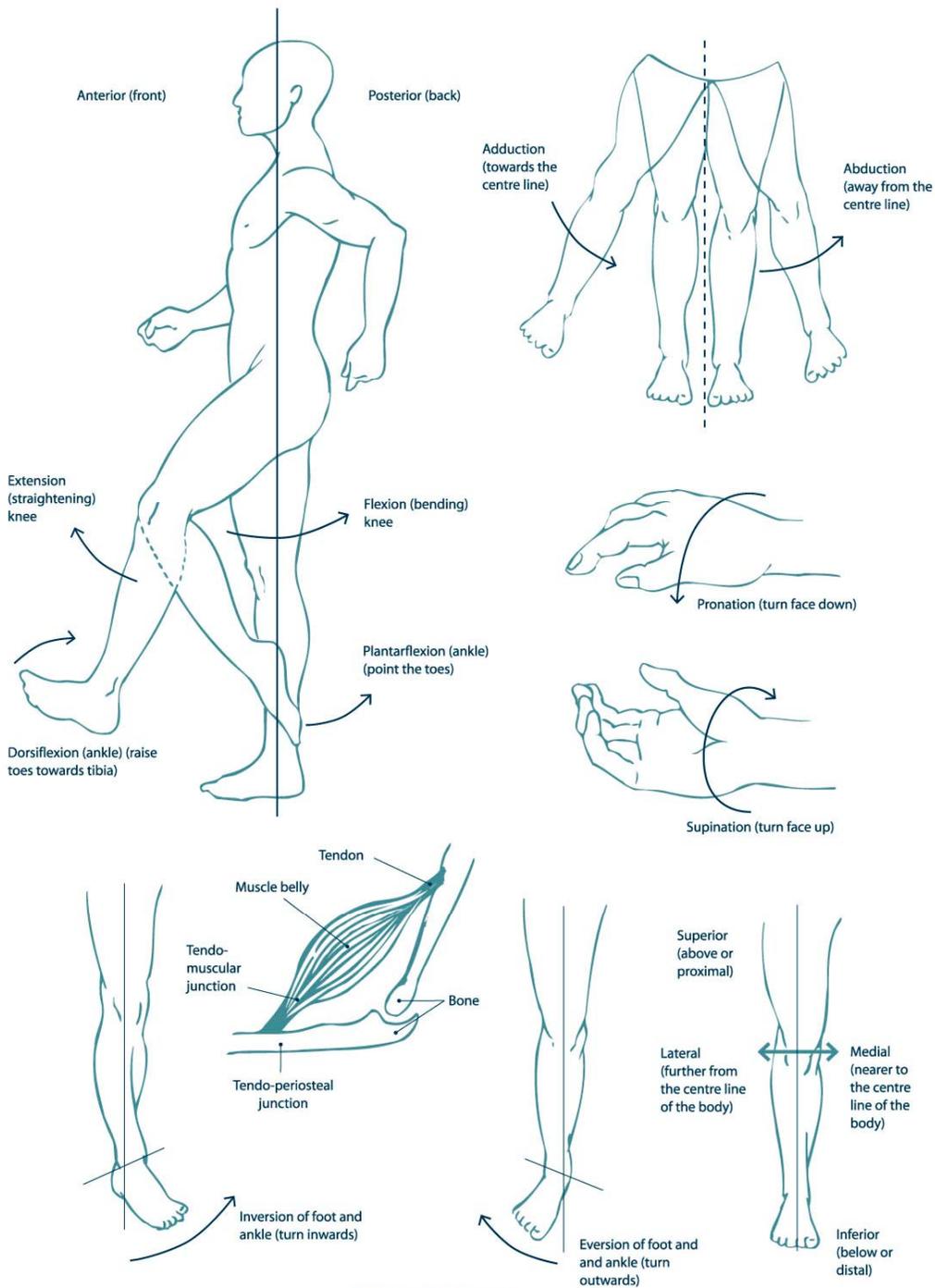


Fig.11 Anatomical terms.

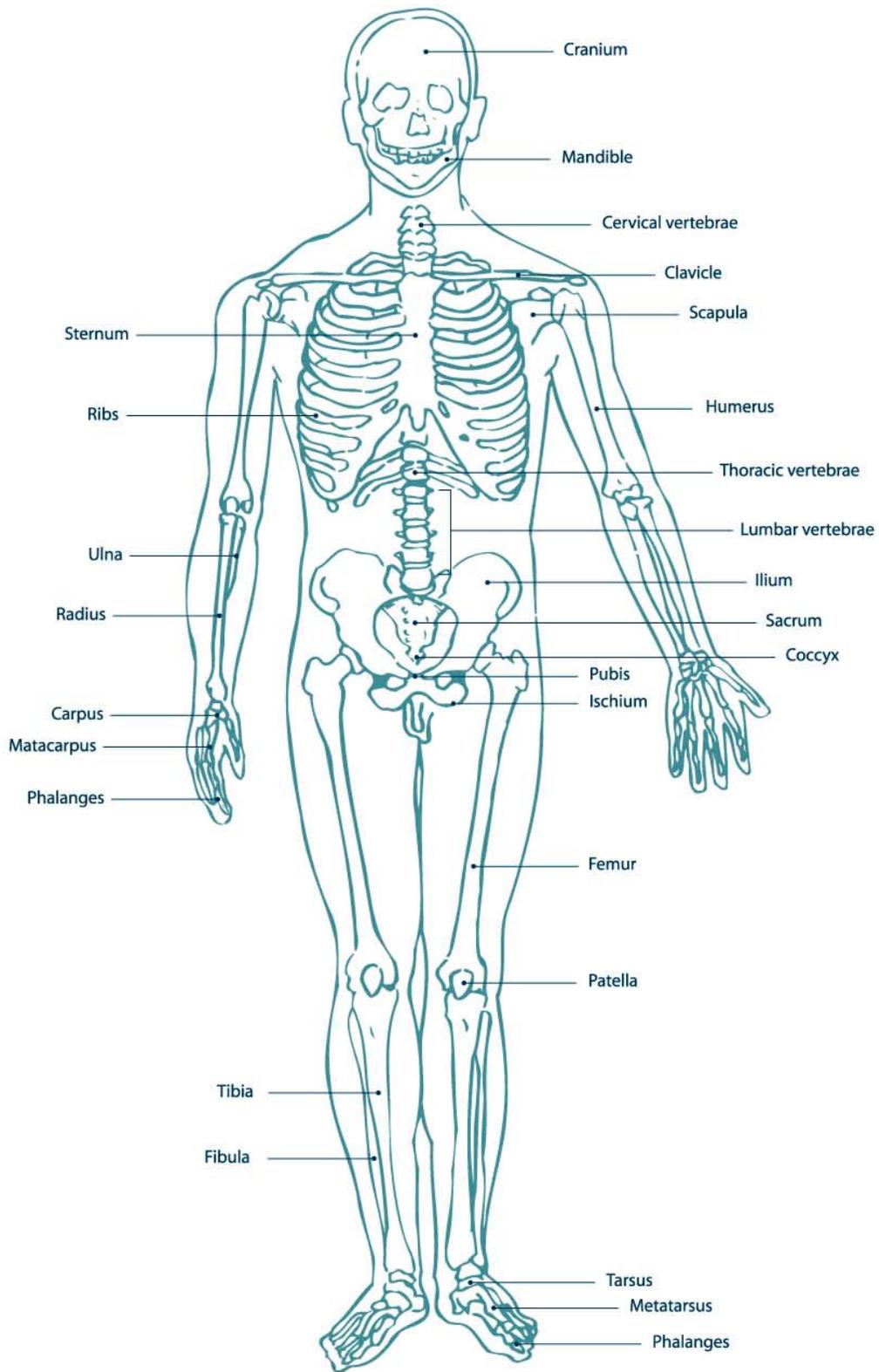


Fig.12 Human skeleton – anterior view.

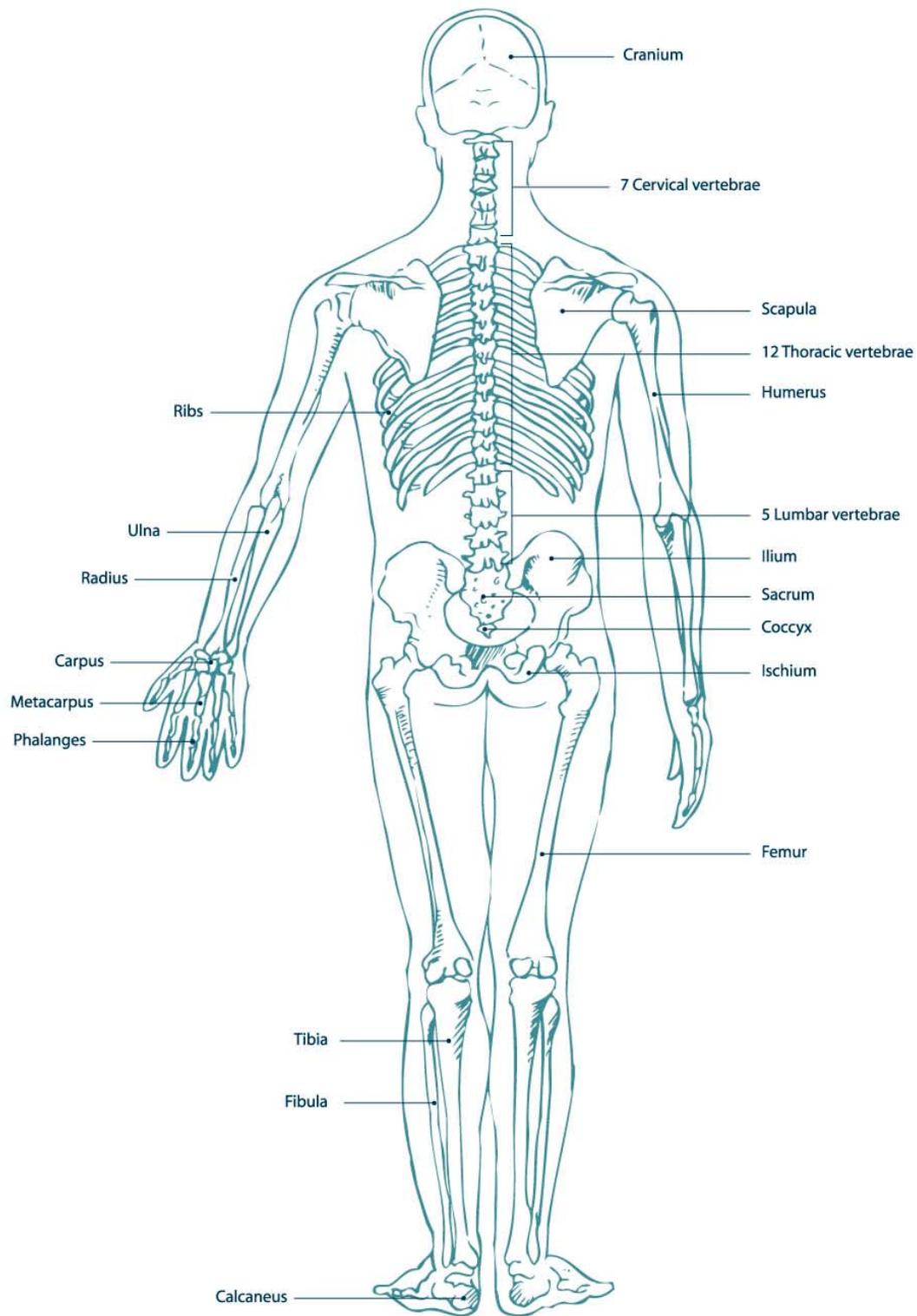


Fig.13 Human skeleton – posterior view.

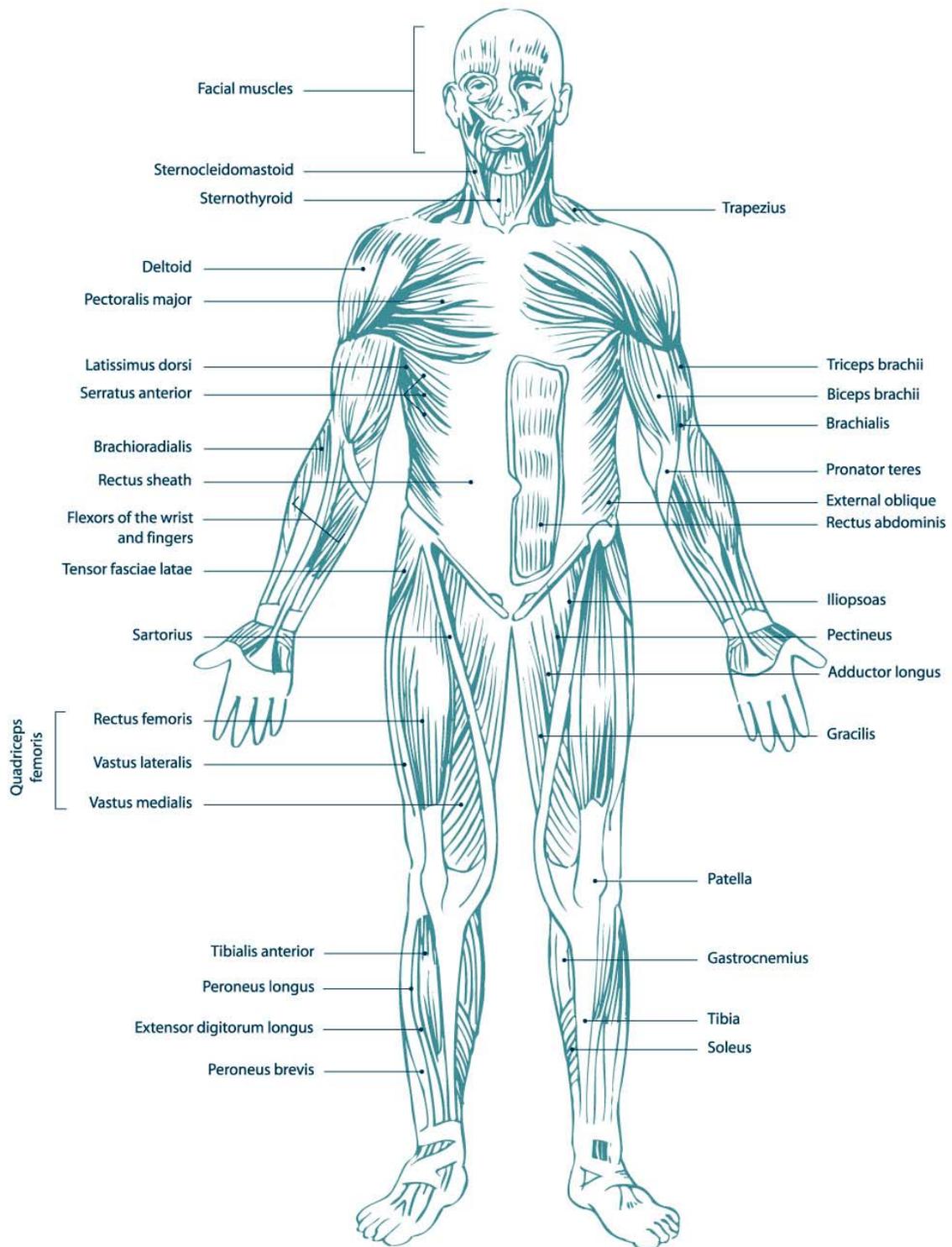


Fig.14 Muscles of the human body – anterior view.

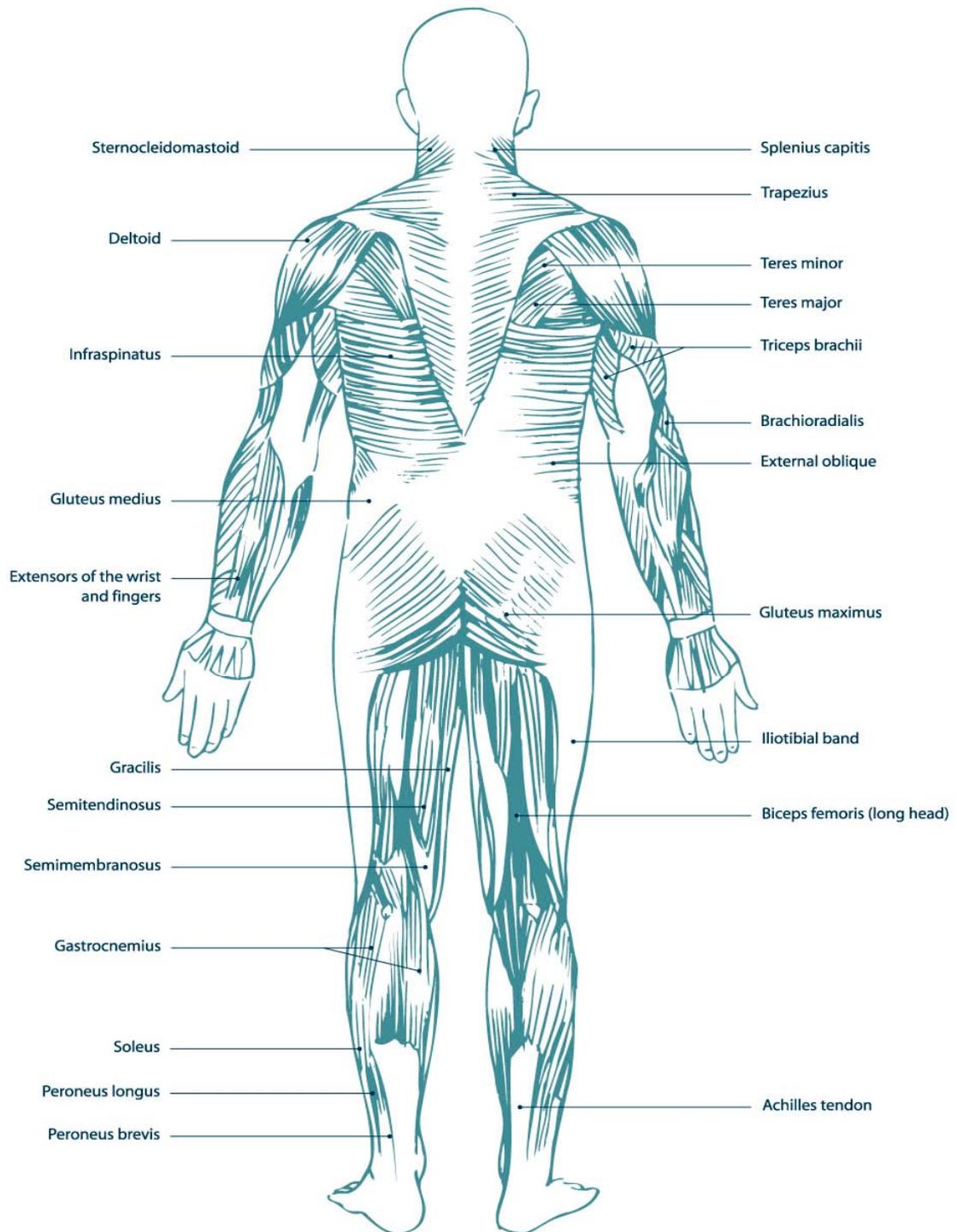


Fig.15 Muscles of the human body – posterior view.

Self Analysis:

Describe your perceived strengths and weaknesses as well as your personal physical goals

Goals Specific, Measurable, Achievable, Realistic, Time	Strengths	Weaknesses

Fitness Assessment Results: (using a sport-specific test – if applicable)
