

FUNdamentals of Climbing 1: **MOVEMENT**

**Coach
Resource Pack**



FUNDamentals of Climbing 1:MOVEMENT

A Workshop for Performance Climbing Coaches

Part of the training pathway for the Mountain Training Coaching Award Scheme

Resource Pack

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For: the British Mountaineering Council, the Mountaineering Council of Scotland and Mountaineering Ireland



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FUNDamentals of Climbing 1: MOVEMENT

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Additional Papers:

- LTAD e-pack
- MCofS Coach Support Pack
- MCofS Booklet: *Children... Hill Walking, Climbing, Mountaineering: Information for Parents*
- MCofS FactFiles

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1. Long Term Athlete Development (LTAD)

A Brief Summary

“It takes 10 years of extensive training to excel in anything”

Herbert Simon – Nobel Laureate

First described by Istvan Balyi (National Coaching Institute, British Columbia, Canada), LTAD was a means of identifying sequential stages for training and competing in sport for children, taking account of their physical, mental and emotional development phases.

1.1 Achieving a Climber’s Potential

LTAD is not all about elite level climbers. A specific well planned training, competition / activity and recovery regime will ensure optimum development throughout a climber’s career. Success comes from training and performing well over the long term rather than peaking in the short term. There is no short-cut. Rushing to achieve success at competitions or on the crag will always result in shortcomings in physical, technical, tactical and psychological abilities:

ELITE:

We now know that a long-term commitment to training is required to produce elite athletes in all sports. The Nobel Laureate’s quote above is backed up by scientific research that has concluded that it takes between 8 and 12 years of structured training for a talented athlete to reach elite levels (Bloom, 1985; Ericsson et al, 1993; Ericsson & Charness, 1994). This has become known as the 10yr or 10,000hr Rule. This equates to 3hrs of practice a day for 10yrs (Salmela, 1998), often neither achievable nor desired by most climbers.

PERSONAL POTENTIAL:

Achieving elite performance is but one aspect of the LTAD theory as applied to those individuals who are identified as Talented Performers, who show commitment to the required training and will go on to achieve elite level (in competition or climbing standards). However, the same theory and strategy, applied to everyone taking up climbing, will mean a greater chance that an individual will achieve their own personal potential at whatever that level is.

LIFE-LONG ACTIVITY:

A strategic approach can only be good for the sport as it will increase the standard of good practice in training available to recreational climbers, thereby reducing the incidence of chronic injuries that have plagued our sport when operated as a pastime. Individuals will be able to climb harder for longer followed by a continued enjoyment of the sport throughout their lives. This will also increase their likelihood to stay with the sport in later years through retraining as coaches or other positions.

1.2 The Principles of the LTAD Stages

The following stages of LTAD were designed to apply to most sports:

Long Term Athlete Development			
	An Active Start	Basic play	0-6yr
Stage 1	FUN damentals	Basic techniques: ABC etc.	Focus on Fun (game learning)
	Learning 2 Train [additional stage for 'Late Specialisation' sports]	More advanced techniques: movement, body position, finger, hand and foot positions (climbing)	General & sport specific training but with more focus
Stage 2	Training 2 Train	The optimal window of 'Trainability': critical periods of physical and skill development	Sport specific techniques through the period of growth spurt
Stage 3	Training 2 Compete	Performing basic and sport specific skills in competitive conditions including mental preparation	Learning Competition tactics
Stage 4	Training 2 Win	Physical, technical, tactical, mental and ancillary capacities now fully established	Optimising performance
Stage 5	Retirement and Retainment	Moving into sport related careers that may include coaching, officiating, sports administration, media, masters competition etc	Re-training; Volunteering - putting something back; sport development

LTAD Stages: KEY NOTES:

- Climbers who get a poor introduction in Stage 1 will not be able to perform in any sport and may be put off sport for the rest of their lives.
- Climbers who miss stages 2 of training will never reach their full potential, regardless of any remedial programme they may participate in.
- Sports have been categorised into ‘Early Specialisation’ or ‘Late Specialisation’, with Late Specialisation sports adding the additional ‘Learning to Train’ stage which is regarded as the most critical.

1.3 LTAD for Climbing: Athlete or Participant?

The UK Mountaineering bodies have agreed that whilst adopting LTAD principles we have made modifications that better reflect the needs of climbing. Unlike mainstream school sports (e.g. racket and ball sports) climbing excellence is recognised not only in the competitive field against other climbers ('Sport' Climbing is the internationally recognised term for competitive climbing and is performed on artificial structures), but in personal achievement in attaining international standards in the natural environment on rock. A long-term model for coaching of climbing must be applicable to both these areas.

- To change the focus of the coaching we undertake on ‘participation’ rather than ‘athlete’ development: we have adopted the title of *Long Term Participant Development (LTPD)* as a better description of this approach.
- Because of the potential damage to finger growth plates in children, climbing would seem to better fit with a **‘Late Specialisation’** sport development plan.
- The focus at the **FUNDamentals** stage 1 in the LTAD model is usually generic ABC skills of movement whilst sport specific skills begin to be introduced at Stage 2. However, in climbing we feel there is a need to start developing the ABC’s of movement in a climbing context at stage 1.



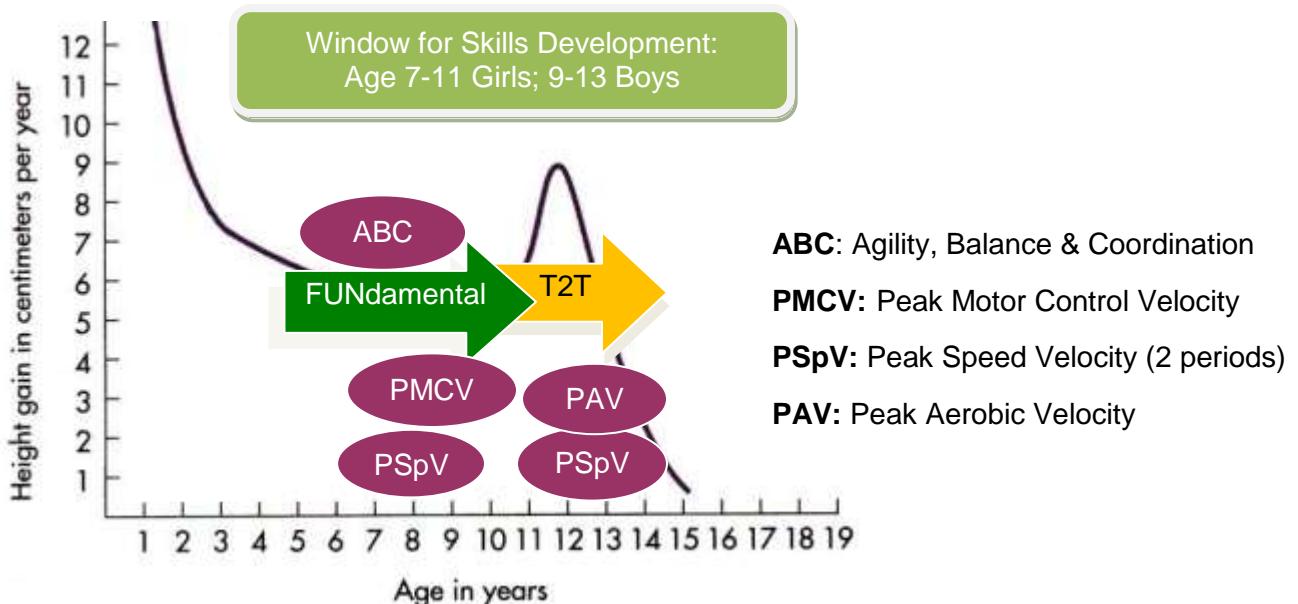
1.4 Critical Periods for Optimal Trainability

Although the workshops focus is on LTPD Stage 1 (**FUN**damentals), we introduce the whole concept of Long Term Participant Development in order to better understand where the **FUN**damentals stage sits in relation to the training stages that follow, particularly the Training 2 Train and the Learning 2 Train stages. A young climber's ability to perform various activities is dependent on their biological ability to do so. We humans develop different biological abilities at different times during our growth as follows:

- Improvements in the central nervous system (motor control & speed of movement)
- Improvements in the capacity for the body to transport and use Oxygen (aerobic energy systems enhancing stamina)
- Developing muscular strength

A good way to assess when these changes are occurring (or are about to happen) is to measure rates of growth in height on a daily basis in relation to chronological age. This is known as Height Velocity, which peaks during puberty (Peak Height Velocity (PHV)). The graph shows when these critical periods occur and that it is important to take advantage of developing different physical skills at the correct times.

FUNdamentals Key Principles (the skills orientated Agility, Balance & Coordination - ABC) therefore should be the focus during the peak periods of the motor control development (PMCV), Aerobic development (PAV) and speed of movement (PSV) as follows:



1.5 LTAD Background Information

LTAD e-pack

As part of this Coaching Resource a series of background papers from a variety of sources have been brought together which explain the thinking behind the LTAD principles. These are available as an e-pack from the MCofS and BMC websites. They refer mainly to mainstream ball sports and similar, but the theory of delivery is the same across all sports. The e-pack contains the following:

E-Pack ARTICLES

Long Term Athlete Development Update, Trainability in Childhood and Adolescence

by Istvan Balyi and Ann Hamilton

Published in FHS (Faster Higher Stronger)

Physical Training of Young Athletes

by Mary Nevill

Published in FHS (Faster Higher Stronger)

LTAD: A Sport Pathway

Extract from A Sport Parent's Guide, pp8-pp15

Published by Canadian Sport for Life (CS4L)

Physical, Mental and Cognitive Characteristics...

Extract from LTAD Resource Paper, pp53-pp61 (see below)

Published by Canadian Sport for Life (CS4L)



RESOURCE DOCUMENTS

(available as downloads from the MCofS FUNDamentals web page)

LTAD Resource Paper

Published by Canadian Sport for Life (CS4L)

<http://canadiansportforlife.ca/>

A Sport Parent's Guide

Published by Canadian Sport for Life (CS4L)

<http://canadiansportforlife.ca/>



Overview of Literature on LTAD:

CLASSICAL:

Age independent models

- Nadori (1981)
- Martin (1977)

4 stage models, i.e., child, juvenile, junior and adult – or basic, intermediate, advanced and elite:

- Thiessen-Seibmann (1959)
- Filin (1964)
- Tschiene (1970)
- Hess (1971)
- Feige (1978)
- Frey (1980)

Anti-early specialisation models:

- Matveyev (1957)
- Stemmier (1959)

CONTEMPORARY:

Bloom (1985)

- Developing Talent in Young People (tennis & swimming)

Bompa

- Generic, with reference to sport specificity (1995)

Drabnik

- Generic (1996)

Balyi

- Generic (1995 and 1998)
- Soccer (1998)
- Alpine skiing (1999)
- Volleyball (2000)

➤ **Itad, the System and Solutions**

by Istvan Balyi
Published in FHS, Sports Coach UK's Quarterly Coaching Magazine January 2002.

➤ **Itad, Multiple Periodisation, Modelling and Normative data**

by Istvan Balyi
Published in FHS, Sports Coach UK's Quarterly Coaching Magazine. Issue 4, May 1999, pp7-9

➤ **Paradigm Shifts in Coaching**

by Stvan Balyi and Graham Rose
Published in BC Coach's Perspective

2. Introduction to the FUNDamentals of Climbing

The FUNDamentals of Climbing 1 introduces **5 Key Climbing Principles** to teach / coach someone new to climbing at a basic level. These are critical movement skills that form the foundation of future climbing ability and are then built upon by introducing specific climbing techniques (FUNDamentals of Climbing 2). They are the building blocks for sport specific skills.

For this reason, the FUNDamentals of Climbing 1 Workshop is for coaches introducing children to climbing, particularly at the formative ages defined by theory from the Long Term Participant Development model.

2.1 The Key Principles

1. Warming Up
2. Agility, Balance and Coordination
3. Centre of Gravity
4. Weight Transfer
5. Economy of Movement

Some of the Principles are generic to all sports: the ABC's (**Agility, Balance and Coordination**) and **warming-up** are good examples which do not necessarily have to be learnt through climbing, but by simple games and movement – the sort of sport performed in Physical Education lessons at Primary School level in a school gym or playground.

Agility: is the ability to change body position efficiently;

Balance: is the ability to control the body's position, while either stationary or moving;

Coordination: is the ability to integrate agility, balance, flexibility, (+ strength, power and endurance) so that effective movements are achieved;

AND:

Flexibility: is the ability to perform a range of motions that enhances ABC.

However, the concepts of **Centre of Gravity** and **Weight Transfer**, although undertaken in simple games on a horizontal surface, are best coached in a climbing specific context from an early introduction and are practiced at this FUNDamentals stage on low angled wall surfaces.

2.2 Warming Up

(Adapted from 'Early Warming Advice', CLIMB magazine, March 2000 by Dave Binney & Steve McClure)

Warming up prepares the body in a number of ways:

- Increases heart rate and body temperature
- Increases blood flow vessel dilation
- Muscles and tendons become elastic and injury resistant
- Improved neuromuscular efficiency
- The brain gets ready for action
- Increases enzyme efficiency



In a nutshell, warming up prevents a 'flash pump', stimulates the neuromuscular system and helps avoid injury. Basically your warm up should get you moving by including an easy version of all the movements you will be doing when you climb.

Step 1: Cardio

(Low Level Aerobic Activity)

The first thing that must always be done and can always be done, no matter where you are, is raising overall body temperature: running, skipping, jumping on the spot for 5-10 minutes, (anything really that expends energy).

The importance of this part of the warm up cannot be overemphasised.



Children competing in the Youth Climbing Series National Final undertake their aerobic warm up

Step 2: Mobility

(Dynamic Stretching)

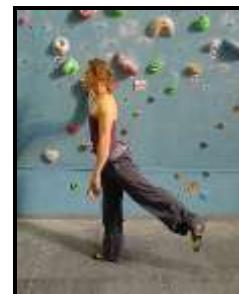
Climbing involves putting your arms and legs in totally different positions from other daily activities of living. Your arms are almost permanently above you head and your legs are often splayed to the sides. During these contortions your muscles, tendons and joints are put under considerable strain so it's important that they are warmed up properly to function maximally and avoid injury. Joint mobility exercises, swinging your arms like a windmill can help warm up the shoulder joint. Similarly swinging your legs backwards and forwards at the hip and also in a circular motion will help warm up the hip joint. See below for more detail and examples.

Step 3: Climbing

(Kinesthetic Awareness)

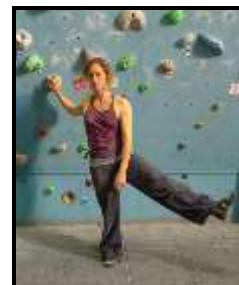
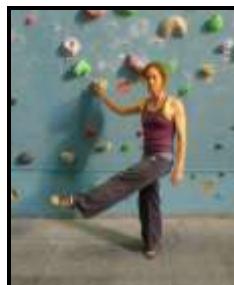
Obviously some climbing is required in order to get the brain and body functioning correctly in unison. So what to do? Ideally choose a problem you've done before and know well. If it's new then beware of under-grading or one-move boulder problems which could lead to a flash pump or injury. If you have got it wrong and instantly get pumped then accept it, give up and take time out to recover fully. Start easy and build up gradually. If this is not possible then find some big holds near the ground and simply move around (up, across and down) for several minutes.

**Basic
Dynamic
Stretches for
warming up**



**See page 16
for more**

Gentle swinging of
the legs back and
forward



Gentle swinging of the legs side to side



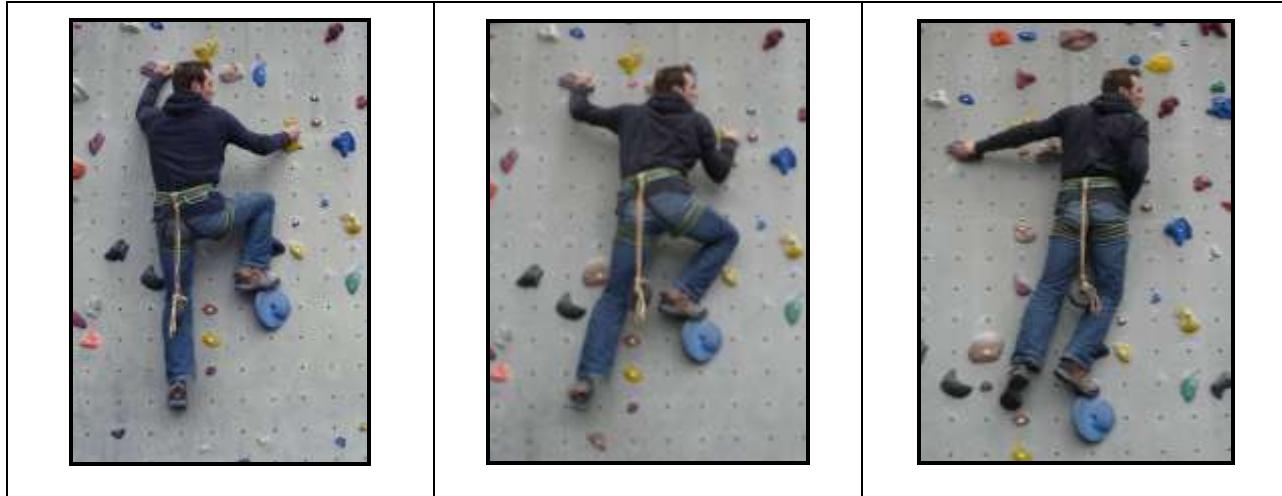
Circling the arms



An easy warm- up on large holds as a circuit
which incorporates vertical and steeper areas

2.3 Centre of Gravity Awareness

When standing upright the centre of gravity (CoG) is located around the lower abdomen, we can think about this as having most of the body weight being approximately centred in the hips. So the key is to put the hips in a position such that the legs, which are stronger than the arms, do more of the work. This is easily demonstrated with a pendulum attached to a harness:



Different rock angles require different movement skills to achieve this, but the basic principle of using the legs as much as possible is valid on all angles such as on this slight overhanging wall:



The climber is in balance; the CoG is over the right foot (indicated roughly by the position of the chalk bag); the left foot is placed on the next foothold

The hips are moved horizontally leftwards; the left knee is moved leftwards, the CoG is moved towards the left foot

Once the CoG is over the left foot, the left leg is straightened up; the CoG remains over the left foot during the step-up

The left leg is now straight and the CoG remains over the left foothold; the climber is in balance

Coaching Tech: Centre of Gravity Awareness

How to do it (on slabs)

If a novice climber can climb a slab in a controlled way without using their hands, they will have gone a long way to understanding where their centre of gravity is:

Start by getting the climber to balance on a slab on one foot using no hands – notice if they can do this better on one foot or the other. There will also be a certain angle of slab that will be too steep for this, and others that are just too easy. Experiment at different walls on different slabs. The climber should then:

1. Standing on one leg, either with no hands, or touching the wall very gently with the finger tips, move one foot up and across to the next foothold.
2. Begin to transfer the hips sideways over the other foot. When the hips are directly over the foot the climber should easily be able to stand up and onto the next foothold, without weighting their arms too much.

Did they find this easy? If not it could be due to two factors:

1. They didn't move their hips over far enough
2. You chose the wrong foot hold for them to use: if the foothold is too high, it will be too difficult to stand up unless they have very, very strong thighs. You can tell it's too high by looking at how closed the knee joint is when their hips are over the foot.
3. So make sure they take small steps and move their hips over their feet enough. When they are getting confident with this, try to bring in a more dynamic movement as they step over or up. Also start twisting the feet and ankles, using the inside, toe and outside parts of the foot. By doing this, the hips will change positions and be brought closer or further away from the wall. These details all affect where the centre of gravity is.

2.4 Stretching and Flexibility as part of a climbing routine

Introduction

Warming up is a vital part of a climbing routine and involves gentle aerobic activity, joint rotation and easy climbing. Most people would not consider these movements, particularly those for joint mobility, as ‘stretching’, but it is one form of several different types.

The two main types applicable at FUNDamentals stage are:

- **Dynamic**
- **Static**

Climbers can often get stretching wrong (bad practice being passed from older climbers to young novices), and a FUNDamentals coach should know some basic stretching exercises for climbers and should be able to offer advice about the do’s and don’ts of stretching, particularly the different stretches required before and after climbing.

Dynamic Stretching

The joint rotation in a warm-up is producing gentle dynamic stretching of muscles, tendons and ligaments. However, this is not a means of increasing ‘flexibility’ (which is achieved by Static Stretching).

What is Dynamic Stretching?

Dynamic Stretching is basically “stretching whilst moving”.

- Used BEFORE climbing as part of the warm-up routine
- Does NOT increase the length of the muscle nor the range of movement of the limb
 - Whilst undertaking aerobic warm-up (e.g. running on the spot, arm rotation etc.) the muscles are moving. The momentum of this movement gently propels muscles through their maximum range of motion
 - Gently increases range of movement, increases blood oxygen to soft tissues prior to exertion
 - Prepares the muscles and joints in a more specific manner as the body is going through movements it will repeat during climbing

Dynamic Stretches for Climbers:

The simple dynamic stretches on page 12 can be introduced with absolute beginners. The following dynamic stretches are more advanced and are more suited to those climbers who have some climbing experience, but would still be termed novices.

Arms and Upper Body

Arm Rotation: the shoulder has the largest range of motion of any joint and requires a full rotation. Circle each arm backwards and forwards, straight armed. Rotate smoothly and not fast.

T Push-up: lying in a push-up position (T Shape) with bent arms, push-up and raise one arm straight vertically into the air as you turn your body sideways. Keep both feet on the ground. Return to original position and repeat. Repeat with the other arm.

Scorpion: From the 'T' shape position, face-down on floor, lift left heel towards right hand & alternate each leg.

Legs and Lower Body (Core)

Forward Lunge: Step forward and drop down low (bent leading leg / extended back leg). At the same time raise the opposite arm to the leading leg high in the air and twist the body towards it. Step back onto the back leg and repeat with alternate leading legs.

Side Lunge: same as above but step sideways and drop the leading leg and touch the ankle with the opposite hand. Try touching the elbow to the ankle if this is too easy.

Carioca: From standing, move sideways stepping one foot across the other, crossing the legs, one after the other for several steps. At the same time, raise arms horizontal to the side and twist the body left and right in sequence to the steps. Move at a fast walking pace. Repeat in the other direction.

Inch Worm: From a push-up position, walk the feet close to hands, keeping the legs and back straight. Walk back down again.

Legs

Straight Leg Kicks: Extend the arm horizontally forward and kick the opposite leg up to touch the hand (keeping the leg straight). Don't kick too hard – keep it comfortable.

Back Pedal: Run backwards with extended long strides.

Knee Hug: Bring the knee up to the chest, clasping the leg with the arms to help at the upper end of the motion.

Contra-indicated Exercises

Go to any climbing wall and you will see climbers performing stretching and warm-up exercises before they climb. Inevitably they are performing out-dated stretches that have now been medically proven to cause injury. These are termed 'contra-indicated' movements. Most climbers would be surprised that they should not be undertaking these exercises:

	<p>Straight leg toe touch (standing with straight legs and bending to touch fingers to toes)</p> <p>Why not: stress to cruciate ligaments and to sacro-iliac joint</p>
	<p>Straight leg windmill (legs apart, bent forward at waist and swinging arms to touch fingers to opposite toes)</p> <p>Why not: stress to cruciate ligaments and scro-iliac joint</p>
	<p>Spinal Circumduction (standing legs apart and spinning the hips horizontally as if keeping a hoola-hoop in motion)</p> <p>Why not: stress to facet ligaments and inter-vertebrate discs</p>
	<p>Neck Circumduction (bending the head towards the shoulder and spinning in a horizontal plane)</p> <p>Why not: stress to facet ligaments and inter-vertebrate discs</p>

	<p>Swinging Rotation (standing legs apart and rotating the body at the waist to each side)</p> <p>Why not: stress to facet ligaments</p>
	<p>Bouncing leg stretch (crouched with one leg extended and the other bent and bouncing down into the crouch)</p> <p>Why not: Leads to ligament, cartilage, tendon and muscle fibre damage</p>
	<p>Hurdle Stretch (laying on the ground with one leg forward and the other bent backward as if clearing hurdles and leaning forward and pulling the front leg's toe towards you)</p> <p>Why not: stress to medial menisci and medial collateral ligament</p>
	<p>Bunny Hop (crouched start and spring into the air and back down to crouch)</p> <p>Why not: stress to menisci and cruciate ligaments</p>
	<p>Sit Ups (classic sitting upright with bent legs and lowering body to ground and back up again – either with or without hands behind the head)</p> <p>Why not: causes adaptive shortening of the iliac phaos hip flexor; pelvic tilting and hyper-lordosis of the lumbar area; when hands are held behind the head it also causes stress to cervical ligaments</p>

Static Stretching

(Information supplied by Theresa Tait MTI ACMT BA Dip)



At the FUNdamentals stage increasing ‘flexibility’ is regarded as important as one of the main ‘enablers’ of the other Key Principles of agility, balance and coordination. Increases in flexibility are best undertaken by static stretching and there is good evidence that stretching, particularly after exercise, prevents injury.

What is Static Stretching?

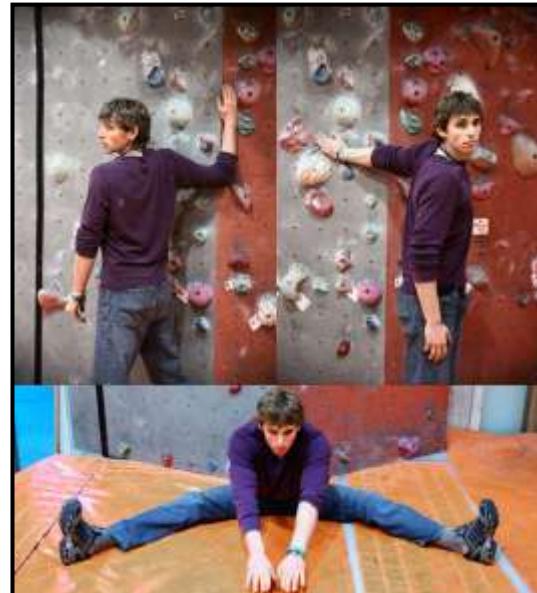
The main aim of the stretch is to move a specific muscle or muscle group to the extreme limit of its extension.

- Used AFTER climbing ('Cool-Down Stretches')
- Static stretching IS used to extend the range of motion of the limb

Static Stretching is the most common form of stretching. The body is placed in the required position and simply held for a desired period of time (5-10 seconds).

It has the following advantages:

- Returns the muscles to their pre-exercised length
- Reduces muscle soreness
- Reduces the risk of injury
- Increases blood supply to the muscles
- Increases strength gains by up to 20% when compared with training for strength without stretching
- Improves coordination



Static Stretching Do's:

Stretching is easy enough to learn how to do, but there is a wrong way and a correct way. A climbing coach should have a good knowledge of best practice and which stretches to avoid because they cause injury.

Correct: undertake a sustained stretch whilst remaining relaxed

Incorrect: bouncing up and down against the muscle and stretching to the point of pain

Undertake the usual warm-up routine (warm muscles stretch more easily and safely), including some very easy climbing

1. Hold the stretch constant (with only a feeling of mild discomfort)
2. Try to remain relaxed during stretching
3. Keep initial stretch hold-time under 10 seconds during initial stretching
4. Once fully warmed up and after preparatory stretching engage stretches for 20+seconds
5. Use a full range of stretches in the routine
6. Stretching after climbing is possibly more important: after exercise the muscles are more susceptible to stretching gains
7. Don't use the stretches that cause injury (see **Contra-indicated Exercises** above)

Although the FUNDamentals of Climbing 1 Workshop does not cover this item in detail, there may be an opportunity to introduce basic stretching theory as part of the warm-up/cool-down process within the Workshop, and so this section of the Resource Pack should be regarded as additional information.

Basic Static Stretches for Novice Climbers:

The following couple of static stretches may be used with novice climbers after a climbing session to aid recovery, reduce muscle soreness and help reduce the incidence of injury:

Forearm (Fingers)		Forearm (Fingers)	
		<p>1. Fingers in the palm of the hand not holding the thumb; 2. Pull back on the fingers gently and slowly; 3. Stop and hold when the stretch is felt in the forearm</p>	 <p>The muscles at the back of the arm (climbing antagonists): their strength & flexibility help prevent <i>Tennis Elbow</i>. Keep the hand clenched into a fist (thumb out).</p>
Flexors	<p>These are the muscles that enable grip. Perform with the stretched arm thumb pointing out (as here) and again pointing in, helping to prevent <i>Golfers Elbow</i>.</p>	Extensors	<p>Also perform in a thumb up and thumb down position.</p>

Upper Arm (& Shoulder)

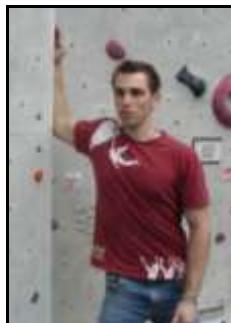
Targets the Triceps but also a mild stretch of the shoulder. Try to touch between the shoulder blades and grab the elbow with the other arm and pull to the back of the head.

Triceps**Upper Arm (& Shoulder)**

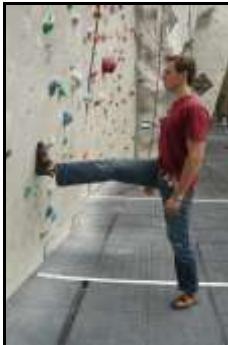
The palm of the hand should be flat; the upper body is turned away from the arm until the stretch is felt in the bicep: the predominant muscles used in pulling on steep terrain.

Biceps**Shoulder**

This targets the Supraspinatus and Rhomboids and Posterior Deltoid muscles of the shoulder and upper back used on vertical and overhanging climbs.

Supraspinatus**Chest**

Targets the Pectoralis Major muscles in the chest as well as the Anterior Deltoid muscles of the back. Keep the palm flat and turn the upper body away from the arm.

Pectoralis Major**Legs**

Raise the foot to waist level onto the wall without assistance, keeping the knee straight, balance and hold.

Hamstring**Upper Legs**

The thigh muscle is used in all step-up moves, particularly on slabs. Keep the legs together and the knee down, held by the hand; and pull the foot towards your back for extra stretch.

Quadriceps



3. Climbing Games

(Cartoon from: Greencreepers.co.uk)

Although the workshop will introduce some games and use them as a means of explanation and demonstration of coaching ideas, this chapter gives FUNdamentals coaches many additional games we feel are particularly relevant and covers basic coaching requirements regarding 'Games'.

Children will learn faster and engage more in the learning process if they are having FUN. Simple games can be used to teach children all aspects of FUNdamental skills:

- Warm-up Games
- Balance Games
- Body Awareness Games
- Footwork Games



**Put your chin on
the blue hold just
under your left foot**

3.1 Game Resource

Most games at FUNdamental level are best suited to floor games initially and bouldering walls for climbing. The resources required are therefore minimal:

- a suitable area of flat ground for general games and discussion (some judo matting would be useful if possible for some floor games, especially for toddlers games)
- a small bouldering facility: slabby and vertical walls are best for these basic skills
- safety matting to the recommended standard below all bouldering areas
- there will be no requirement for technical climbing equipment
- specific equipment for specific games is described below, most are easily made up beforehand

3.2 Game Safety

Safety during the activity is one of the essential responsibilities of a coach. Whilst the usual guidelines for safe bouldering would be applicable, the coach needs to be aware that children engaged in games will potentially be more excited about the activity and therefore more prone to potential injury either from falling/tripping over, bumping into each other (floor games), or injury to their fingers and shoulders (wall games): most children engaged in FUNDamentals will also have less strength in the hands and fingers and will be more prone to injury if they have not been climbing long:

- stay on slab or steep slab walls
- warm up the whole body with aerobic warm up games and joint mobility exercises before starting climbing games
- specifically warm up the fingers and forearms with short-burst easy boulder problems
- do not design any game involving dynos
- ensure game movements are essentially static - encourage precise movements
- encourage static grasping for holds
- ensure children do not hold onto bolt hangers or place fingers in bolt holes
- keep children at a low level – traversing games are good; do not design games that have awkward moves high up

3.3 Games & Biological Age

This chapter gives FUNDamentals coaches a selection of easy to organise games focused at different age groups from toddler, through youth to junior and on different mediums. A description of how they are conducted, the material resources required and further information should help develop your skills and ideas in this field. The number of Games a coach can use is endless and only limited by imagination. Which games you choose should of course be aimed at the relevant age of the children in the group:

- Floor Games for Toddlers (early years 0-4)
- Floor Games for young children (juniors 5-8/9)
- Introducing young children to the vertical (5-8/9)
- Climbing Games focusing on individual skills at FUNDamentals (juniors/early adolescents 5-12)

Floor Games

Building up agility, balance and co-ordination for climbing doesn't necessarily have to happen on the climbing wall. Far from it; floor games are often more effective to develop these skills. Climbing requires body awareness, balance, co-ordination, core, agility, quick thinking, decision making, planning and more. All these skills can be developed out of climbing situations and require thinking outside the box. The options are limitless - just a good imagination is necessary.

The Full-Body Chain

Consider the whole body as a chain of individual links. A body that is strong is one where all links in the chain are equally strong: from the hands, all through the body, down through the legs to the feet. To improve the links in the chain, whole body exercises are necessary. If young climbers are not careful, and they just climb, they run the risk of not developing full body strength and only upper body strength.

Consider the following which can be used for a range of ages from toddler to youth:

1. **Playground style games** (hopscotch, leapfrog, balancing on posts, skipping...) all develop fundamental skills for any sport and climbing is a good example
2. **Obstacle courses**, which involved planning and thinking and possibly team work. Jump on and off boxes (you need to know how to fall off if you are bouldering) to develop leg strength and precision of movement, bouncing, crawling, going fast, going slow...
3. **Balancing**: the classic hopscotch requires balancing on one leg (develop the game to include picking up and dropping off items along the way), balancing along marked lines on the floor, slack-lining, balancing on posts...
4. **Core**: wheelbarrow races, pretending to be animals that have a good core e.g. snakes, crabs, monkeys, and the party favourite of twister. Use gymnastic type moves such as rolling in a ball, rolling on your side

The above are just some ideas and can be used as part of a warm-up or cool-down. They are not just fun, but develop all the skills necessary for climbing.

FUNDamentals Scheme for “Early Years”

This is a generic course for early year children (toddlers) put together by British Gymnastics, but applicable at FUNDamentals for all sports. There are 10 different sections from Warm-up to Cool-down, including locomotive schemes, balance, coordination, hand-eye coordination and spacial awareness, whilst also learning the different parts of the body. Full course and resources are colourful with ‘home packs’ as well as those for coaches.

http://www.youtube.com/watch?v=KO4jv0SghAE&feature=player_embedded

The Junior Climber

The floor games described above offer a great starting point at an early age and conversely you will see below a list of 'Games' that have been devised to help older children understand basic movements in a climbing context. But simple games can include routines on gym wall bars, gymnastic horse, ladders and ropes as well as on climbing surfaces and 'The Junior Climber' links the two: just watch children of all ages at a town playground which has bars, suspended beams and ladders! The coach should not be limited only to the climbing wall surface at this stage.

Indeed, for young children (age 5yr-8yrs) the ABC's can best be introduced in terms of climbing by a mixture of all these methods. It is important to familiarise children with the vertical and this is best achieved by relating it to the horizontal which they are already familiar with. The bouldering wall is by far the best facility for this as it offers an easily managed and safe environment.

So be creative: use ladders (Bachar ladders are usually available at larger walls) suspended from the bouldering wall, ropes suspended near the wall or as hand rails whilst traversing, bring in many of the climbing games outlined later in this Resource Pack.

It is recommended that coaches study the short film made by the FFME (French Federation for Mountaineering and Climbing) entitled 'Baby Escalade' which is freely available on YouTube at:

http://www.youtube.com/watch?v=LVE9Lpx4_cU

Or from the FFME website at:

<http://www.ffme.fr/escalade/video/baby-escalade.html>



Coaching Tech: Ideas for coaching ABC's for very young children

1. Choose a bouldering wall with recommended deep safety matting.
2. Teach them all how to fall off safely through games
3. Make up a 'circuit' comprising climbing on the wall – intersperse different wall angles (including some overhanging) – games on the floor, ladders and ropes
4. Ensure that feet are used at all times on the ladders for younger children
5. Either use rope swings or gym ropes and introduce rope-climbing, using the feet against a vertical wall for those less able to do it without



3.5 Climbing Games

(Based on a paper by Dave Binney & Guido Kostermeyer)
 (Cartoons courtesy of FFME)

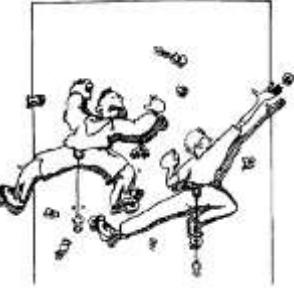
The key is to design a game that concentrates on one particular FUNdamentals skill at a time.
 The following games are given as examples currently being used successfully by many coaches.

	DESCRIPTION	RESOURCE
	One Handed Climbing FUNDamental Skills: Balance: Centre of Gravity Description: The climber has to climb from start to finish markers using only one hand. They should not lean against the wall with their body, but find balanced positions before moving.	Materials: Writing chalk or laminated pictures of start and finish. Important: Make sure the holds are not too far apart – they should not entail a knee bend during step ups of more than 90 degrees.
	The Blind FUNDamental Skills: Body / Spacial Awareness Description: Put 2 climbers together in a team. One team member is the climber the other the announcer. The climber's eyes are covered with a blindfold, so that the climber is unable to see. The announcer's job is to explain the position of holds to the climber. The climber has to climb from start to finish markers. Afterwards the roles are changed. Variation Blind cow: first person climbs blind (after looking at the climb); the other person gives guidance where to place feet and hands	Materials: Scarf and writing chalk or laminated pictures of start and finish. Important: Must be able to complete task before making competitive.
	One Hand Catch FUNDamental Skills: Balance; Agility Description: Three to five persons climb on the wall. After calling the name of a climber, the judge throws a ball to one of the climbers. The climber has to catch the ball.	Materials: Soft ball Important: Keep space between the climbers in case they fall off.



	<h3>Posing</h3> <p>FUNDamental Skills: Coordination; Body Awareness; Flexibility</p> <p>Description: A single climber climbs the wall. (S)he has to find funny or spectacular climbing positions. The other climbers are on the ground and grade the positions by clapping or yelling.</p>	<p>Materials: None.</p> <p>Important: Start on a steep slab for less experienced novices and progress to vertical</p>
	<h3>Take Off</h3> <p>FUNDamental Skills: Body Awareness; Centre of Gravity; Problem Solving</p> <p>Description: Make a team of three climbers. The team starts by making a boulder problem. After having climbed the problem you are allowed to eliminate one handhold at a time until you can no longer do the problem.</p>	<p>Materials: Masking tape</p> <p>Important: Ensure the children make the initial route easy, with several alternative holds</p>
	<h3>Adding</h3> <p>FUNDamental Skills: Route-reading; Problem Solving</p> <p>Description: Two or three climbers make a team. The first climber starts to climb, he stops after two moves (that's two hand movements). The next climber then repeats the first two moves and adds on another two. How many moves can the team link together without failing?</p>	<p>Materials: Masking tape</p> <p>Important: The task is more difficult if the footholds are specified or if on a featured wall by using the features for feet only</p>
	<h3>Getting dressed</h3> <p>FUNDamental Skills: Balance, agility, flexibility</p> <p>Description: Items of clothing are placed around the wall. The climber must try to maintain balance and hand(s) free posture in order to put them on. There are different clothes (cap, glove, t-shirt etc) on different holds in about 1.5 meter distance. Climb from one item to another and put the clothes on. You can do it as a competition: two persons against each other.</p>	<p>Materials: Items of clothing. Keep them simple initially – hats gloves, zipped fleeces</p> <p>Important: Make sure there are no climbers directly below. Ensure large holds are used for hands or feet.</p>



	<h3>Plumb line</h3> <p>FUNDamental Skills: Centre of Gravity; Weight Transfer</p> <p>Description: Attach a figure 8 to the climber's waist using a piece of cord. The aim is to only move your foot when the figure 8 is over the other.</p>	<p>Materials: Figure 8 and cord</p> <p>Important: Get the children to perform this in both directions</p>
	<h3>Circle Circle</h3> <p>FUNDamental Skills: Balance; Coordination</p> <p>Description: mark out or place a hoop on the wall. The climber has to complete as many circles as possible in 1 minute. Variation: mark the circle in chalk and climb around or inside the circle.</p>	<p>Materials: Hoop or chalk or stretch cord</p> <p>Important: Make sure there is no chance the hoop can catch on their feet and cause them to fall.</p>
	<h3>The Jigsaw</h3> <p>FUNDamental Skills: All ABC's</p> <p>Description: Two or three climbers make a team. You will need several different pictures some cut up into 2 and other into 3 pieces. Place the pieces on the wall as close to or actually on different holds. Each climber retrieves a picture piece from the wall a places it on the floor. The task is to find which pieces make whole pictures.</p>	<p>Materials: Several laminated pictures (in pieces), blue tack.</p> <p>Important: Make sure that the climbers down-climb rather than jump off</p>
	<h3>Hidden Rest</h3> <p>FUNDamental Skills: Base of Support; Centre of Gravity</p> <p>Description: The instructor identifies various body positions enabling rests on the wall. The task is for the climbers to find these hidden rests.</p>	<p>Materials: None</p> <p>Important: Give precise instructions as well as demonstrate</p>

	<h3>Simon Says</h3> <p>FUNDamental Skills: Balance; Reactions;</p> <p>Description: 'Simon Says, raise your arms out by your side then raise one leg and hold for 10 seconds. This is then followed with the other leg. Repeat without the EYES CLOSED, and then repeat without the arms. Simon Says raise out your arms then raise one leg straight out in front. Hold this position then rotate leg to the side, hold, and then rotate until leg is behind body. This is then followed with the other leg. This is repeated without the EYES CLOSED. The whole exercise is then repeated without the arms.</p>	<p>Materials: None</p> <p>Important: This must be performed on a slab to be effective. Angles between 85 and 75 degrees are good. Make sure there is little chance of slipping onto large footholds.</p>
	<h3>Balloon</h3> <p>FUNDamental Skills: Straight Arm, Base of Support and body twisting (FUNdamentals of Climbing 2)</p> <p>Description: Put a balloon under your shirt and climb with the balloon. You will have to twist and keep your body tension low while climbing.</p>	<p>Materials: Balloons</p> <p>Important: None</p>
	<h3>Noughts & Crosses</h3> <p>FUNDamental Skills: Efficiency of Movement; Problem Solving; Body & Leg Twisting</p> <p>Description: The climber must complete the boulder problem by only placing the foot on the hold which corresponds to the same marker as the hand.</p>	<p>Materials: chalk or cards marked '0' or 'X'. Blue-tack or cellotape.</p> <p>Important: Keep it simple.</p>
	<h3>The Artist</h3> <p>FUNDamental Skills: Base of Support;</p> <p>Description: Place an A4 piece of paper on the wall e.g. an outline of a face. The task is for the climbers to add features to the outline one at a time. Each climber adds one feature. You can make this harder by climbing to the picture one handed.</p>	<p>Materials: A4 paper, coloured marker pen, string and drawing pin.</p> <p>Important: If using one-handed, ensure good spotters.</p>

More Climbing Games

1. **Balancing** on a fence.
2. **Walking** on rocks without falling down - who can go the furthest.
3. **Walking** on rocks without standing on a wobbling stone.
4. **Chain**: 4 or 5 children are on the wall on the same height 1,5 meters apart. They pass a flower (or anything else) from person to person.
5. **Climbing sideways**: the climber always looks at a quick-draw or point on their hip while traversing.
6. **Statue**: one climber is doing a movement, and the other one imitates it exactly.
7. **Thunderstorm**: the leader is -Thunderstorm- and looks away from the wall. The kids climb on the wall. When the leader shouts "thunderstorm", he or she turns around. If somebody still moves, the climber has to stop or to begin again, or will be the "thunderstorm".
8. **Who is quicker**: In the middle of the wall a towel is hung. On either sides of the wall a climber starts to reach the towel first.
9. **Collect points**: Holds are marked with points (1, 2 or 3 points depending on the difficulty). The group collects points in, say, 10 minutes. Everybody has to climb not only the best!
10. **Countdown**: Everybody stands 3 meters away from the rock. The leader counts from 10 to 0 (or from 5 to 0); by zero everybody has to be on the wall (no foot on the floor!)
11. **Cat and mouse**: The mouse has a towel on its back and starts to climb sideways. The cat counts to 20 and tries to catch the towel from the mouse.
12. **Find the treasure**: On some holds sweeties are hidden. The climber who finds it may keep it.
13. **Crossroad**: At either side a person begins to climb. At the point they meet they climb over the other person without touching the floor.
14. **Crater**: Fix two ropes from left to right: Climb in between the ropes. Hand and feet have to be inside, or the same outside.
15. **2 left, 2 right**: fix a rope from the top to the ground. Climb with hands on the left hand side of the rope and feet on the right.
16. **One hand or one foot**: climb either with one hand or one foot.
17. **Giant or ant**: Climb with very big or very small steps.
18. **Stay on your path**: Mark some holds. Try to climb by using only the marked holds.
19. **Puzzle**: 2 groups, two puzzles. The pieces of the 2 puzzles are laying on holds in 2 different sections. Each group climbs up gets the pieces (one at a time) and builds their puzzle.
20. **Tolpatsch (clumsy)**: Climb from one side to the other. On the holds for the feet are little stones. The climber tries not to knock the stones off.
21. **The tale of the devil**: Two climbers. Each wears a towel on their back. They try to catch the towel of their partner!
22. **Music**: Climb in the rhythm of the music. Slow music = slow movements or quick music = quick movements!

4. Coaching Skills

4.1 How we learn

Successful teaching of any subject (particularly to children) requires an understanding of how we all engage in the learning process. In essence this means active participation by the coach and the participants, using a variety of techniques: ‘demonstration’ and ‘evaluation’; ‘understanding’, ‘doing’, ‘practicing’ and ‘correcting’ at all stages.

Children have a shorter attention span than adults and require constant re-iteration (repetition by variety) of key principles by a range of different delivery mechanisms.

4.1 Coaching Mechanisms

What techniques can a coach use to encourage learning?

It is important the coach can use a range of different approaches at different times. They all have their place and it is a skill to be able to judge when each is most appropriate.

Instruction & Explanation

Only 10% of information is conveyed by the words we use; 40% is conveyed by how they are spoken; 50% is conveyed by gestures and body language.

- Application
 - Best to keep instruction for describing specific skills.
 - Use when time is limited.
 - Use when there are important safety factors.
 - Use more with adults rather than children.
- Process
 - Keep it simple and jargon free with minimal content.
 - Plan in advance exactly what is to be said.
 - Gain the group's attention before starting, maintain eye contact and look for understanding in the whole group.

Asking Questions

Questioning allows coaches to gain a rapport with students. It engages and motivates them. It encourages students to take personal responsibility for what they are doing, self-evaluate and solve the problem themselves which significantly increases learning. However, it requires practice.

- Application
 - Use the technique when instruction fails.
 - Use when time is not limited.
 - Use on a one-to-one basis for individual correction.
 - Combine with participant demonstrations (see below).
- Process
 - Try to avoid single-word answer (“closed”) questions.
 - Plan in advance questions to ask in relation to the skill being taught.
 - Listen to the responses and give positive rather than negative feedback.

Demonstrating

Demonstrations are an important part of coaching and learning. To be effective they should be used at the correct time.

- Application
 - Use when describing a specific technique, particularly movement skills.
 - It is particularly good in the early stages of learning a new technique.
 - Use a competent member of the group to act as demonstrator: Advantages include motivation, group control and instant evaluation by the coach but understand the limitations of accuracy and bad practice.
 - Use video when appropriate to illustrate a technique.
 - Use with children, when it is a more powerful tool than instruction. Children respond well to demonstrations especially when linked to Questioning (see above).
- Process
 - The demonstration needs to be an accurate replication of the technique being taught.

- Plan the demonstration in advance to focus on one specific point or element of the technique.
- Position the demonstration so everyone can clearly see it and there are no distractions.
- Gain the group's attention before starting, maintain eye contact and look for understanding in the whole group.
- Use questioning during the demonstration to encourage understanding.
- Repeat the demonstration several times, breaking down the technique by identifying specific elements.

Observing & Listening

“Coaches should watch and listen more than they speak”. 90% of understanding takes place non-verbally. Listening to what the group members are saying gives insight into their understanding and observing their activity is a vital skill for a coach in order to evaluate and correct a coached technique.

Development of observation skills is paramount to being an effective coach. Observing the climber from multiple angles (e.g. side, front and back) is beneficial in giving the coach a number of different perspectives. For the first few observations, look at the whole movement in general to gain an overall impression of the skill performance. Then focus on one aspect of the movement at a time.

- Application
 - At all times.
- Process
 - Break down the technique and observe each element in order to identify any difficulties.
 - Concentrate on one element at a time.
 - Vary your observation position.

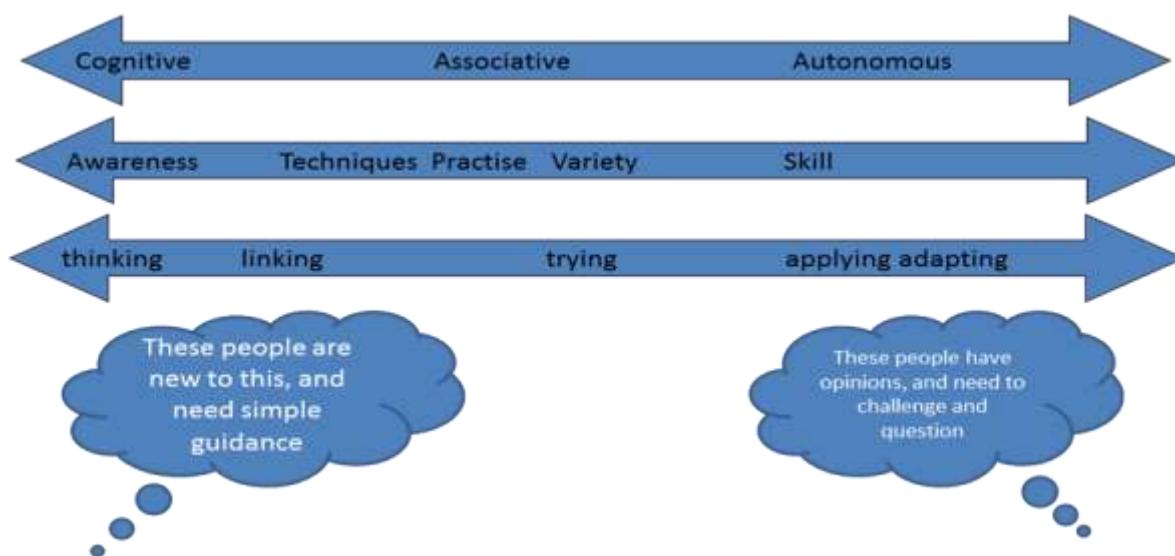


4.2 Skill Acquisition

How does someone learn or improve a skill?

The starting point is to understand how experienced that person is at the given skill or activity in the first place. Are they a beginner or an expert or somewhere in between? Their level of expertise will affect how you coach:

- Beginners will require being shown or told how to do something in more of a descriptive manner. They will be using their conscious brain to work out how to do the skill for the first time. There will be a lot of ‘thinking’ as they need to practise the skill a large amount for it to begin to go into the subconscious brain. Imagine being shown how to palm in a corner for the very first time. Climbers will require demonstrations and the skill to be broken down into component parts.
- Climbers with a moderate level of expertise will be able to call on past experience and link to the current situation, however the process still takes time. They will need practise the same skill in many different environments to embed that skill further. Here the climber will know how to palm but now they need to apply in different environments with poor feet, or hands or smoother rock for example.
- An expert climber will require less demonstration and being told. This climber can call on a wealth of previous climbing experience. The skill is already autonomous, but needs refining. Questioning is more important as they will have a sense that something needs improving but they will have a greater role in bringing it out of themselves with a coach’s direction. More advanced techniques such as video analysis can be used.



Steps to a skilful performance

- Whole – part – whole:** Introduce the whole skill (the final version), then break it down (what is happening with the feet, hips, arms, head, fingers etc – as below). Finally bring all the parts back together to make up the whole skill. When learning a new skill a climber needs to have full awareness of the skill, where all the component parts are understood.



- A person has awareness that there are many techniques that can be applied to any one skill e.g. crack climbing, arêtes etc.
- Repetition: there are no short cuts to becoming an expert. Remember the 10,000 hours or 10 year rule. Practise, practise, practise...
- Learn in a variety of environments and situations
- Finally you will have full ownership of a skill, where it is completely autonomous and aware of areas, which require refinement.



5. Bibliography

Climbing Instructional Books:

The following books should be part of a climbing coach's collection and relate mainly to safety.

The Beginners' Guide for Climbers

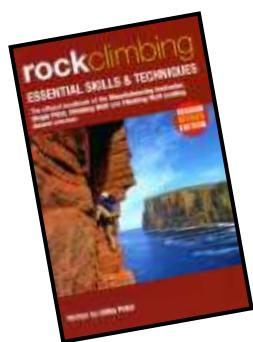


By Sophie Mitchell, Published by RockFax

Endorsed by the MCofS

A NICAS support book containing safety information as well as a great basic introduction to techniques discussed at the FUNDamentals stage. Good 'cartoon' style illustrations suitable for children make this a vital resource for those coaching through NICAS.

Rockclimbing



Essential Skills & techniques

The Official Handbook of the Mountain Instructor and Single Pitch Award Schemes

By Libby Peter; Published by Mountain Training UK

Chapter 3 'Getting Moving' has a basic introduction to techniques used in climbing, but the handbook is mostly concerned with the safety aspects of climbing.

Rock Climbing



Introduction to Essential technical Skills for Leaders and Seconds

By Pete Hill; Published by Cicerone 2007

Chapter 6: Moving on Rock. An extensive chapter covering basic information about handholds, footholds, climbing specific types of rock angle and formation.

Coaching Subject Matter:

The following books contain more detailed descriptions on coaching techniques.

Climbing Games



By Paul Smith, Published by Pesda Press 2009

A teaching aid that gives practical advice on a variety of games used to coach warm-up, balance, body awareness and footwork.

Top Tips for Climbing Coaches



By Paul Smith. Published by Pesda Press 2009

Literally a mini-aid-memoir of tips for coaches and instructors, covering everything from children's first climbing sessions, to winter instruction.

Climbing Wall Leading

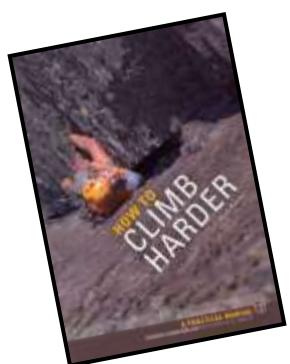


Learn to lead efficiently on climbing walls

By Ian Fenton; Published by Pesda Press

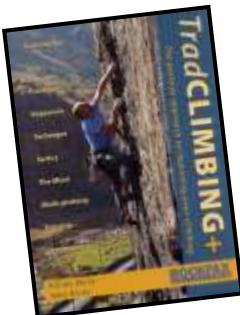
Although essentially an instructional handbook for teaching leading, there are sections on warm-ups, games and exercises relating to lead climbing.

How to Climb Harder



By Mark Reeves; Published by Pesda Press 2010

Starts off with coaching information about how we learn, followed by a progressive series of movement exercises to help 'learn' the techniques. Also training advice is included. The Pesda website includes all the illustrations from the book available as downloads (free) for use in presentations! <http://www.pesdapress.com>



TradCLIMBING+

The Positive Approach to Improving your Climbing

By Adrian Berry and John Arran; Published by RockFax 2007

Chapter on technique focusing outdoors on rock features but covering all the same movement techniques as that of sportCLIMBING+ but in a traditional setting.



SportCLIMBING+

The Positive Approach to Improving your Climbing 2nd Edition

By Adrian Berry and Steve McClure; Published by RockFax 2006

Chapters on Tactics and Techniques which has helpful information on pre-climb stretching, and good information backed up with photos and diagrams on balance and body position.

General Subject Matter:

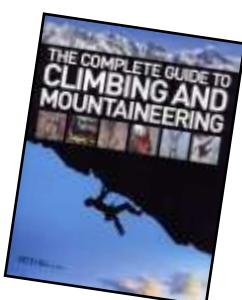
The following climbing or mountaineering books contain some chapters on climbing technique.



The Complete Climbing Manual

By Tony Lourens; Published by New Holland 2005

Chapter 4: Essential Skills and Technique. Contains basic information about body positioning, slab, face and crack climbing techniques, and as an American book it contains a lot on off-width techniques and American-specific names.



The Complete Guide to Climbing & Mountaineering

By Pete Hill; Published by David & Charles 2008

Chapter 3: Movement, Bouldering and Climbing Walls. A short section covers different handholds, footholds and specific techniques such as lay-backing.

6. Web-based Information:

The following websites contain climbing technique and coaching information:

Kids Climbing

www.kidsclimbing.co.uk

Covers many general aspects of kids climbing in the UK

The Self Coached Climber

www.selfcoachedclimber.com

Dan Hague's forum with lots of views and ideas.

Climbing Coach

<http://climbingcoach.blogspot.co.uk>

<http://icoachclimbing.com/>

Mark Reeves blog and App site

Masterclass Coaching Academy

www.masterclasscoachingacademy.com

Neil Gresham's coaching scheme

The On-Line Coach

<http://onlineclimbingcoach.blogspot.co.uk>

Dave MacLeod's coaching blog.

Appendix 1

Glossary of Types of Hold:

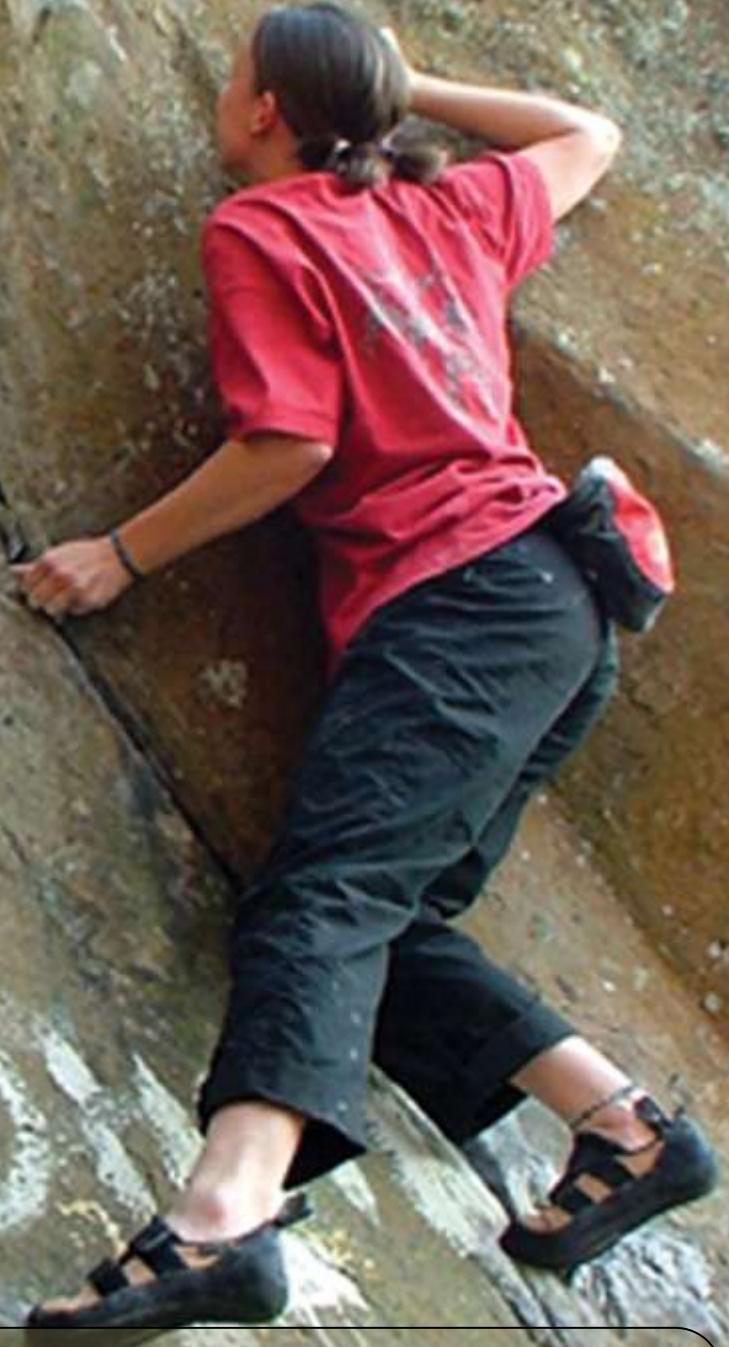
Jugs Large holds that can be easily gripped often with the full hand and the fingers wrapped right over the top as if holding onto a bar.		Slopers Holds that are sloping downwards and have nothing to 'hook' your fingers over.	
Edges / Crimps Usually small holds that have a sharp edge to them and only the first joint of the fingers can hold them.		Pockets Holes in the rock surface that usually allow finger tips only (1-2 digits deep). They can vary in size from allowing one finger to several fingers to be used.	
Wraps / Guppies / Mould Holds that you wrap your hand around. These can often offer respite during a climb as they rest the fingers more than you would think!		Presses / Palming Any part of the climbing surface can be used as a 'press' where the whole palm of the hand is used to press down onto the rock.	
Side pulls 'Vertical' holds that face sideways and have to be grasped usually with the thumb pointing upwards, forcing the body away to the side of the hold – a 'layaway'. Correct body position and balance is important to be able to use these holds.		Flakes Larger side-ways facing holds that force a laying away action like a side-pull, but for usually more than a few moves up the flake.	

Jams Usually vertical cracks or vertical slots. An open hand can be inserted, then attempted to form a closed hand or fist until the sides of the crack meet the sides of the hand. Maintaining pressure maintains the jam.		Arêtes The reverse of a corner – a feature on the wall that looks like a corner turned inside-out. It can be a 90 degree arête (as pictured) or more or less angled. Layaway moves are required.	
Undercuts 'Up-side-down' holds: holds with the gripping part in the underside and the hands grip them palm-upwards.			Undercuts can be large (upside-down jugs) or very small (upside-down crimps). They all give the opportunity for increasing vertical reach and can be invaluable climbing through roofs.
Pinches Holds that have to be pinched between fingers and thumb to be securely held. They vary from single finger-tip holds to continuous limestone 'Tufas'.			
Gastons Side-ways facing holds that force a pressing action against the hold rather than a laying away action.			Usually gastons are held thumbs-down and allow movement away from the hold



Appendix 2

FUNdamentals of Climbing 1		COACHING SESSION PLAN	
 A Workshop for Performance Climbing Coaches			
Date:		Coach:	
Venue:		Participant Information: <small>(Ability level, medical issues etc.)</small>	
Duration:			
No. Participants:			
Session Aim / Objective: <small>(discusses aims for session / reminders, evaluate have line ability etc.)</small>			
Introduction <small>(discusses aims for session / reminders, evaluate have line ability etc.)</small>			
Warm-up activities:	Skills and games:	Coaching tips/questions/challenges:	Class management/energisers:
			Cool-down activities:
			Equipment Required:
Review/evaluation <small>(key points from session, what worked and what did not, modifications for next session, etc.)</small>			



FUNDamentals of Climbing 2: TECHNIQUE

Coach Resource Pack



FUNdamentals of Climbing 2: TECHNIQUE

A Workshop for Performance Climbing Coaches:

Resource pack

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1. Complex Climbing Movements

1.1 Introduction

The FUNdamentals of Climbing 1 introduced the 5 Key Principles for introducing someone new to climbing at a basic level: the ABC's and warming up being particularly important followed by 'Games' that help understand basic movement on the wall. The concept of Centre of Gravity and Weight Transfer was introduced and practiced on low angled wall surfaces at a basic level.



In LTPD terms it is also clear that whilst coaching young novice climbers still at the FUNdamentals stage it is important to concentrate on developing technique rather than physical training such as a regime of pull ups. More significant is an 'at the wall' training schedule that many young climbers may have of climbing lots of routes on at least 4 nights a week, but with poor technique. This simply ingrains any poor skills and further limits progression.

A novice climber will quickly graduate from easy climbing on even-surfaced slabs to trying steeper routes with a variety of climbing features (arêtes, corners, roofs etc.). Most climbing walls have a predominance of vertical and overhanging areas and it will not be long before even younger climbers will start climbing relatively easy but overhanging walls.

But such novices are still developing their technical skills at this stage and it is therefore important for coaches to concentrate on delivering advice that helps a novice tackle these varied climbing situations.

1.2 Putting FUNdamentals 2 into Context

Of the **Key Principles** of movement that were introduced in the FUNdamentals of Climbing 1, the two most important items that climbers require a greater understanding of, to help them cope with climbing's varied situations, are now developed in The FUNdamentals of Climbing 2 as follows:

Centre of Gravity and Weight Transfer

Body Movement

(Introducing "Base of Support" & "Momentum")

Novices must develop an instinctive understanding of these skills, but also develop a quality of performance and range of application. This will be undertaken through investigating the detail of:

- **Footwork and use of Handholds**
- **Body Awareness and Balance**
- **Techniques for climbing Steep Rock**



This Resource Pack is aimed at giving Coaches:

1. Background detail of FUNdamental climbing techniques
2. Coaching ideas related to these techniques

1.3 Style and Technique

Style: “A particular, distinctive or characteristic mode of action or manner of acting”

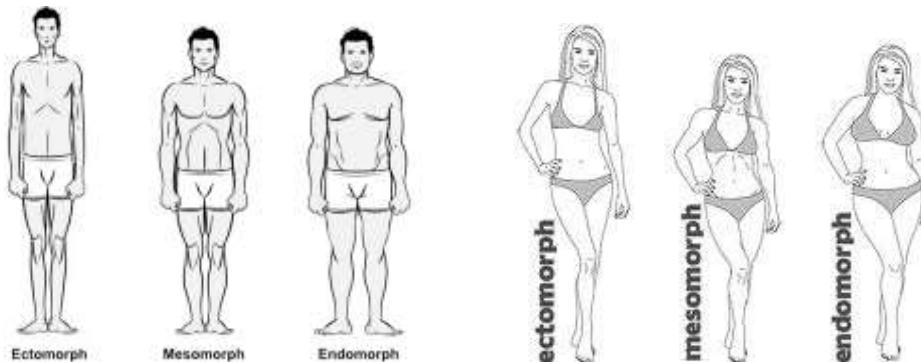
Technique: “the systematic procedure by which a complex task is accomplished”

Personal Style:

The style of climbing exhibited by a climber will probably be very personal to their body dimensions and morphology (type), musculature and make-up of their muscle fibres.

Body Morphology & Somatotype:

First described by the ancient Greeks (!), and then in modern times by W H Sheldon in 1940, when he described the three ‘somatypes’ below.

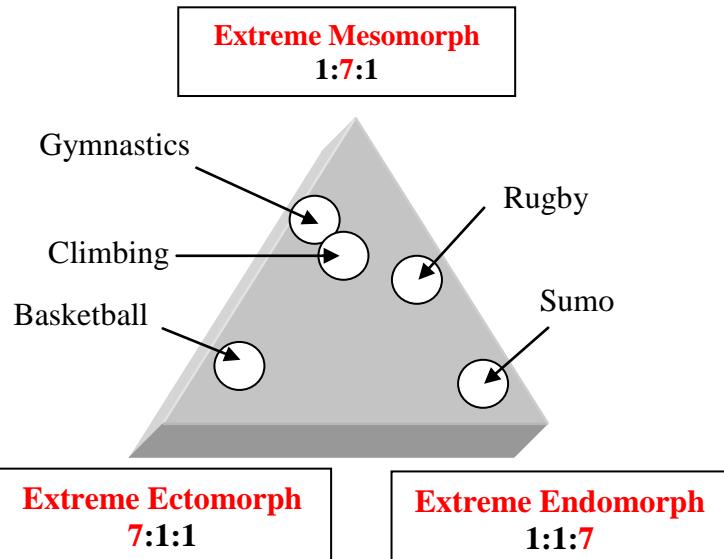


Images courtesy of [Govt. of Western Aust. Dept. of Health](#)

Ectomorph	Mesomorph	Endomorph
<p>Generally tall and slim</p> <p>Small frame and bone structure</p> <p>Lean muscle mass</p> <p>Flat chest and small shoulder width</p> <p>Fast metabolism : finds it hard to gain weight, either fat or muscle</p> <p>Good at endurance (aerobic) sports</p>	<p>A naturally athletic physique</p> <p>Large muscular build</p> <p>Rectangular shaped body</p> <p>Naturally strong</p> <p>Gains muscle mass easily</p> <p>Finds it easy to maintain body weight ratio and strength</p> <p>Will be good at most sports</p>	<p>Generally short with a "stocky" build (thick arms / legs)</p> <p>Round physique</p> <p>Muscles not so well defined</p> <p>Gains muscle and fat very easily</p> <p>Slow metabolism: finds it hard to lose fat and stay fit</p> <p>Good at strength/power sports</p>

Sheldon maintained that no-one will conform to just one of these stereotypical morphological types, but will note characteristics of all. He then evaluated the degree of body type present in an individual on a scale of 1 (Low) to 7 (High). This (somatotyping) allows body type to be compared between athletes (NB: height is not taken into consideration other than in general terms).

The 'perfect' types for different sports could be as shown opposite:



What does this mean for climbing?

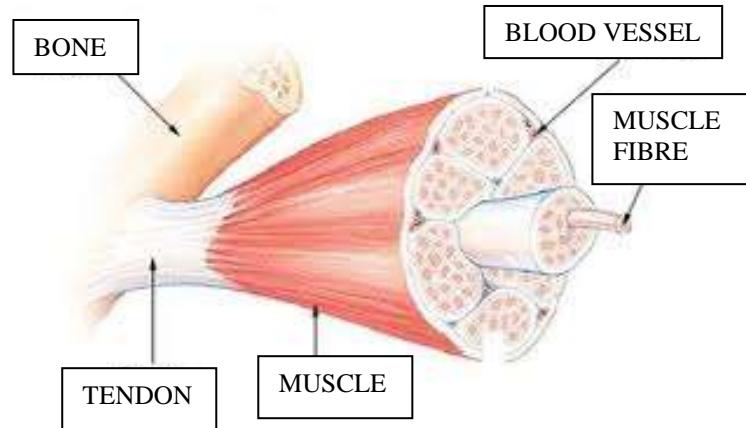
Climbers' physiological characteristics will determine, in a generalised way, their style of climbing as follows:

Ectomorph	Mesomorph	Endomorph
High strength to weight ratio	Higher strength & power	Lower strength to weight ratio
Strength is low across the whole body	Strength is high across the whole body	Strength is high in the legs & arms
Will try and use both arms and legs at all times	Will use arms in preference to legs	Will use legs more than arms
Will find steep slab and vertical walls easier to climb	Will find overhanging walls easier to climb than others	Will find slabs or easy angled walls easier to climb
Tends to use both static and dynamic movements	Tends towards dynamic movements	Tends to be more static in their movements
Will tend to use balance well and appear 'balletic'	Will tend to use body core to help all moves	Will get pumped quicker in the arms than the legs
Will exhibit sustained stamina – can hang on forever!	Will exhibit a more explosive climbing style	Will exhibit slow climbing style
Has a long reach so will tend to use it more than other types, as well as use high step-ups more, as they tend to be flexible	Will be power oriented and will make dynamic moves over shorter climbs	Shorter stocky build means shorter reach and use of more numerous and smaller step-ups to compensate

Muscle Physiology:

Although this aspect of a climbers' physiology becomes more important when considering Physical Training than climbing style, it is generally accepted that it can have a bearing on the style of climbing that an individual is genetically better suited for.

There are three muscle fiber types, which contract in different ways and influence how muscles respond to physical activity: slow and fast (twitch) fibers. Muscles contain a genetically determined mixture of both slow and fast fiber types, the average being 50%:50%. But muscles are incredibly adaptive and they can be altered through specific training (e.g. sprinters can possess 80% fast twitch fibers, while marathon runners can have 80% slow twitch fibers).



Slow twitch (Type I): operate aerobically (with oxygen), have low force production, are slow to fatigue, and so are good for stamina. Postural muscles in the neck, back and legs contain large % of these muscles. The fibers are the smallest in diameter and red in colour.

Fast twitch (Type IIa): operate both aerobically and anaerobically and so produce fast strong contractions for a longer period than Type IIb, but fatigue faster than Type I. They are pink with an intermediate diameter.

Fast twitch (IIb): operate anaerobically (without oxygen), and produce short bursts of strength, and are good for maximum power, but are quick to fatigue. They are found in large % in the muscles of the arms. Luckily for climbers they can be changed to Type IIa by training. They are white and are the biggest in diameter.

Climbing Style Performance: Under normal activity Type I muscle fibers are used first, then Type IIa when more strength is required and then Type IIb when maximal strength is required. Our genetically predisposed muscle fiber %ages may influence what style we are naturally good at, stamina or power.

What does this mean for a Coach?

“Different Climbers Climb Differently”

When coaching a specific climbing technique, the coach must be able to distinguish between the individual's style (based on their morphology and muscle fibre predisposition) and the execution of the technique itself. The coach must apply the technique within the climber's style.

If a climber is having difficulty performing a technique, forcing them to try a movement in a specific way which does not conform to their style, it will be counter-productive, creating negativity and frustration and reducing the effectiveness of the coaching.

Climber Physiology and Style:

Consider some well-known climber's different morphological types and consider how they climb:

	<p>Johnny Dawes: Mesomorph; Somatotype: 2:6:5 Below average height (5ft 3 inch) for an elite climber; naturally athletic with a muscular build; generally explosive dynamic style of climbing; exceptional on steep slabs and gently overhanging ground.</p> <p>PHOTO: Simon Nadin</p>
	<p>Alex Puccio: Mesomorph; Somatotype: 3:6:3 Average height; naturally muscular build; a strong / powerful style aided by dynamic movement; specialises in bouldering.</p> <p>PHOTO: Chris Noble Photographic Arts</p>
	<p>Dave Macleod: Mesomorph; Somatotype: 2:7:3 Average height; slim muscular build; both methodical and dynamic style exhibiting stamina; elite all-discipline climber.</p> <p>PHOTO: John Watson</p>
	<p>Lucy Creamer: Ectomorph; Somatotype: 5:4:2 Average height; slim build; combines both a slow methodical style with a degree of dynamic movement; specialises in sustained stamina climbs around the vertical.</p> <p>PHOTO: Tim Gladsby</p>
	<p>Adam Ondra: Ectomorph; Somatotype: 7:3:1 Perhaps at the extreme end of the Ectomorph type for a climber; very tall; very slim build; 'staccato' style of fast movements aided by constant dynamic pulls; uses extensive leg flexibility; exceptional on long stamina sport routes.</p> <p>PHOTO: Black Diamond.com</p>
	<p>John Dunn: Endomorph; Somatotype: 1:3:5 Average height; large muscular build; slow methodical and static style, even when dynamic!; renowned for being very strong whilst training but gains weight easily and must train stamina, and diet to maintain good climbing body-weight ratios; specialises in all types of lead climbing.</p> <p>PHOTO: Kevin Howett</p>
	<p>Malcolm Smith: Endomorph; Somatotype: 2:3:5 Average height; large muscular build; slow powerful style; also renowned for dieting (on steak and broccoli) to maintain climbing weight-ratio; specialises in bouldering and short very steep routes.</p> <p>PHOTO: John Watson</p>

1.4 Using Holds



The FUNDamentals of Climbing 2 investigates in more detail how a novice climber can affect their Centre of Gravity and make Weight Transfer more efficient in a variety of climbing situations, achieved predominantly by combining the efficient use of:

- 1. Footwork &**
- 2. Handholds**

The workshop concentrates on climbing techniques associated with hands and feet and how they link with the features on the rock, and how small alterations in the use of these can greatly affect the outcome. The following information supports the practical delivery in the workshop:

1.4 Footwork

The legs and the body's core muscles are the strongest and most powerful muscles in all climbers, whereas those of the forearm are often the weakest. This can be especially so in young children. These larger muscle groups are therefore vitally important for movement across rock and in order for the body to use the strength contained in them, good footwork is vital. In relation to the Key Principles of climbing, the main issue is weight transfer between feet whilst climbing.

There are 5 key areas for developing good footwork which will be investigated as follows:

1. Building a mental awareness of using the feet and legs
2. An understanding of the different usable parts of the feet
3. Using the most effective part of a foothold
4. Precision and accuracy in foot movements
5. Fundamental foot movement techniques

1.1 An Awareness of using the feet and legs?

Watch a novice climber ascending a route at a climbing wall and you will notice how they concentrate mainly on their hands and moving their body weight upwards principally by pulling up on holds with their arms. With the arms being the weakest link in the body, particularly for novices who will not have trained their upper body, this is a very inefficient method, despite it being the most intuitive way to climb.

On slabs and most walls up to vertical, the legs are the best muscles for making upward progress. They can exert greater strength by pushing down on holds than the arms could ever hope to achieve pulling up on holds. Here, the arms are principally for balance and allowing the body to get into position to use the feet and legs. Good footwork is the key to this process as this leads to confidence to push hard with the legs.

However, many climbers struggle initially to effectively use their legs and continue to concentrate on their arms. In which case movement between holds becomes difficult; balance will be poor as the feet position does not allow the legs to push effectively in the correct direction to reach the next hold. This leads to out of control moves with attendant uncontrolled swinging and twisting of the body during the move. This is inefficient, tiring and prone to cause injury.

There are two elements to focus on as a coach to help develop this vital **FUND**amental skill:



The feet are rigid and too high

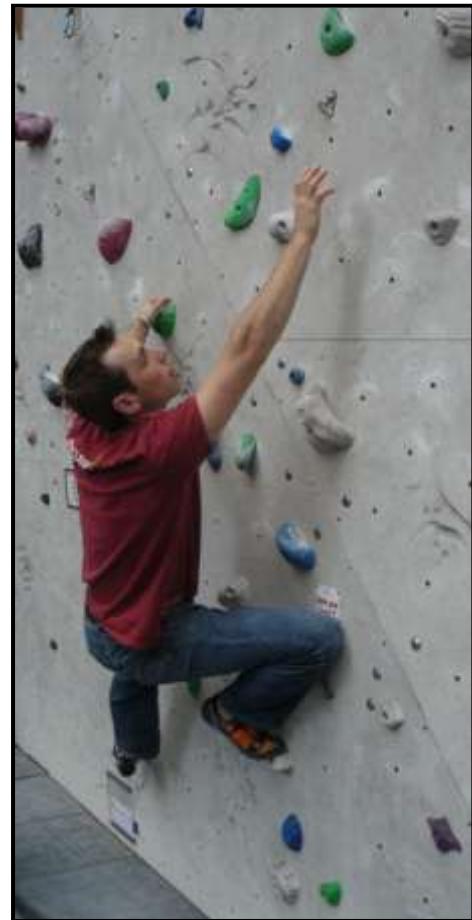


The arms are doing all the work

Learning to use the legs in climbing:

Rock-over moves used in FUNDamentals 1 to practice weight transfer and balance can be extended as a series of exercises on ever steepening ground to reinforce the use of the legs. A progressive series of exercises can be made from easy slabs to near vertical walls (but not at this stage to vertical and overhanging terrain) with low step-up heights (below knee-height) on large footholds and without arms/hands pulling on holds. Problem design should force the hands to only be used for balance by choosing poor sloping holds or small side-pulls, to reinforce the necessity to use body movement and the legs to move upward.

Once the climber has practiced this, it is also worth altering the step-up height making progressively higher steps (to waist height) and discussing how that affects movement – initially there appears to be more emphasis placed on the arms rather than the legs as the step-up height increases indicating more strength being required in the arms for these movements. But the opposite is actually true for greater climbing economy: although the amount of strength required by the legs under these circumstances can be reduced by pulling harder on the handholds to pull the body more upright from the high-step, the legs are the best muscle structure to utilise as they are capable of greater ‘power’



‘Power’ is the combination of ‘strength’ and ‘speed’ (or movement). It is a measure of the ability to use the strength of a muscle in making a dynamic movement. Since we predominantly use our legs in everyday life the legs will always be more powerful than the arms in making upward movement and this power can be utilised better by altering the centre of gravity to assist the legs. A coach should be able to demonstrate how efficient climbing utilises this concept.

Coaching Tech: Ideas for coaching use of the legs in a step-up

1. Walking up a slab without handholds. Concentrate on pushing with each leg.
2. Progress to a steeper slab/wall. Choose footholds with one higher at about knee-level. Without handholds, focus on upper knee & experiment on how far you can move the knee, keeping in balance. Repeat back & forth. At furthest point, when balanced, push with the upper leg to move upwards. Repeat, this time concentrating on the lower leg to assist the push.

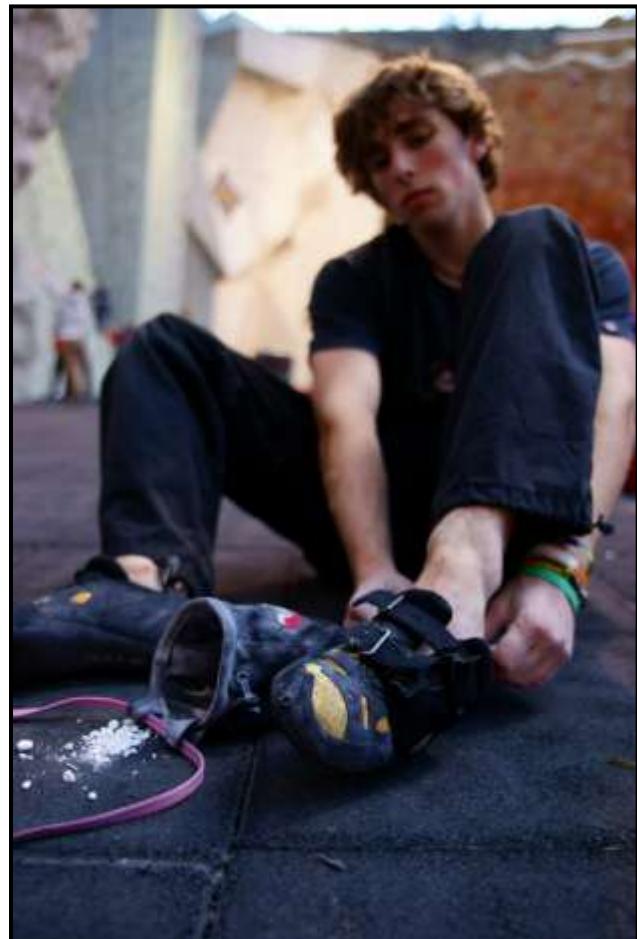
Learning to use the feet in climbing:

It helps whilst developing the awareness of using the legs, to also investigate the use of the feet and what constitutes a 'foothold' or indeed a 'useable' foothold. In order to do this for a beginner, the coach needs to make the climber aware of important properties of the main piece of technical equipment used in climbing – the climbing specific rock shoe.

The coach should have a working knowledge of the following main areas:

Rock Shoes

1. Shape
 - a. Design and function
 - b. Fitting
2. Friction
 - a. What is 'sticky rubber'
 - b. What are the limitations of rock shoes' friction



The friction afforded by these shoes can make a huge difference on the size of the holds that can be used. On indoor walls and on rock types such as sandstone, anywhere on the surface can be deemed a hold under certain circumstances. The key to making best use of this friction is:

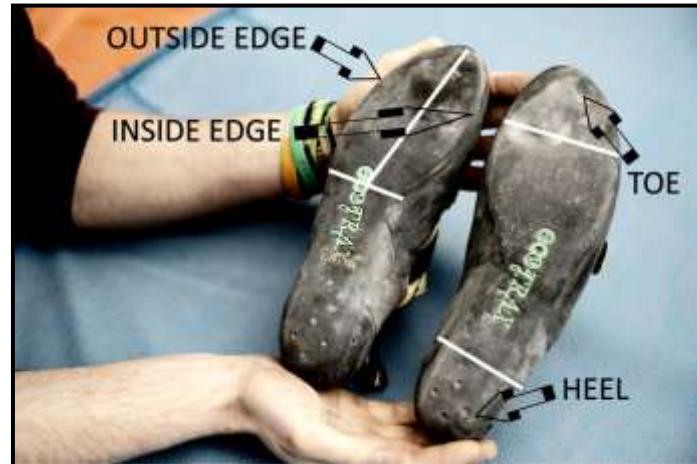
- the way the foot is held against the hold / surface
- the angle of the foot against the wall / hold
- the amount of shoe sole against the surface
- the amount of pressure applied through the leg
- the use of opposing pressure from the other foot.

See **Appendix 1: Rock Shoe Design and Function** for more detail

1.2 The usable Parts of the Feet

There are four different parts of a foot / rock shoe that can be used for different types of movement, direction of movement or on different shaped holds:

- The tip of the toe
- The inside edge
- The outside edge
- The heel



The First Mistake:

It is a common mistake with novice climbers to try and use the arch or ball of the foot on holds. To a novice this feels like an energy efficient use of their feet, as there is less stress placed on the leg muscles, particularly the calf muscle, and so they get less tired. However, this severely restricts the range of movement of the ankle (as well as the foot-leg-hip combination when moving off that foothold) and restricts the length of reach that can be achieved.



It is far better to use the edges of the rock shoe near the big or little toe, which give an element of freedom of movement for the ankle and therefore a greater range of possible movement for the knee and hip joint. It also allows the climber to pivot the leg on the hold further increasing the range of movement.



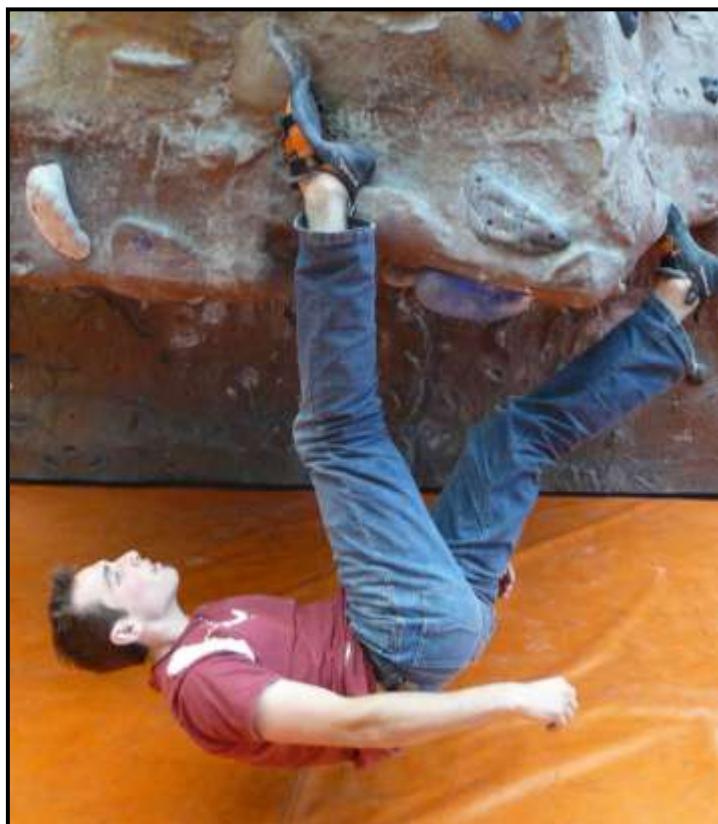
Using the ball on all the hold feels more secure but restricts the movement of the hips and upper body and therefore upward reach



Using the edge of the foot near the toe on just part of the large hold allows ease of movement – allowing greater reach

Heel and Toe Hooking

Rock shoes have frictional rubber across most of the heel and across the top of the toes for a reason! In all situations described in this pack for the use of foot holds and during the workshop, the heel and toe can equally be applied.



Above: Using the ball of the foot is the first beginner's mistake. But this is an example of how it can be used with the heel on a huge hold to 'lock' the body into an overhanging wall.
Left: an extreme example of efficient use of the heel & toe with leg & core strength through a roof.

Heel-Low or Heel-High?

Whatever the shape or size of hold, the objective is to get as much of the rock shoe surface area on the hold as possible, without limiting mobility.

The position of the heel will vary depending on the shape and size of the hold, which also changes the amount of upward movement that is possible from the foothold. This is fully discussed below.



Step-ups

Don't step up too high unless you have no choice. This will make it more difficult to be precise in using the foothold; it will normally push the centre of gravity out from the rock, placing more strain on the arms and it also often requires foot re-adjustment through the move.



Keeping the feet low, even on a smaller foothold, is often a better option for stability and efficiency, better utilising a more stable foot placement.



Making a higher step onto a larger hold places the body in a less stable position (clearly seen here). The higher leg and arms (and core muscles) are now working harder to make the move

1.3 Using the most effective part of a hold

Making an assessment of the best way to use a hold will become easier the more experience is gained from actually climbing. Initially it can be difficult for novices to appreciate how the small differences in the way a foothold is used can alter the difficulty of the move.

For instance, it may appear to be a simple decision to place the whole foot on a large foot hold, but depending on what body position is required to reach and maintain balance for the next move, it may be better to use only a smaller part of it – the far end of the hold, or the close end of the hold; or use the sloping part of a hold rather than the sharper edged part which may appear more secure but may make the move more difficult.

- In general, it is always better to use the outer edge of a larger hold as this helps maintain balance and allows greater ankle movement options.
- Small shifts in foot position will alter the centre of gravity and therefore balance point.

Edge

Basically a very small ‘crimp’ handhold that is being used for the feet! Usually smaller than any handhold. Mostly used by ‘edging’ the inside edge of the big toe or the outside edge of the little toe. The Heel should be above the hold height to maximise the surface behind the lip of the hold in contact with the shoe.



Smear

A sloping handhold used as a foothold! Or even just a slight depression in the wall. The heel needs to be lower than the hold to increase the contact surface area. When moving upwards off the hold, the heel needs to be kept low to maintain the largest area of friction. Otherwise the friction fails and the foot comes off.



Pointed-Toe (toeing-in)

This requires the foot to be at 90 degrees to the wall, standing directly on the tip of the big toe area of the rock shoe. Used on pockets and particularly on small holds on steep rock it also allows greater vertical reach, through full leg and foot extension.



Coaching Tech: Ideas for coaching foot work

1. **'Silent Feet'**: no bumping, sliding, tapping the hold – first time placement only.
Looking at the hold throughout the move.
2. **'Backwards Traversing'**: keep the body at 90 degrees to the wall, toes pointing in the opposite direction to travel, hips in toward the wall or slightly out – whichever feels best. Traverse both directions.
3. **'Pivoting'**: Face-on to the wall, allow space between the toe and wall; twist the knee and heel sideways. Get used to it on different sized holds.
4. **Heel Position Exercise**: stand on a selection of holds and raise or lower the heel to judge which is best to maximise the amount of purchase.

1.4 Precision and Accuracy

The Second Mistake:

Another common mistake by novice climbers is to repeatedly place and replace their feet on holds as if they are unsure the hold can support them.

Accurate placing of the foot on holds increases climbing efficiency. To facilitate accurate foot movements it is helpful to break down the decision making process into stages as follows:



Lean out and look at the footholds and your feet!

- Lean out from the rock to look at the possible selection of holds below
- Choose a foothold that will make the next move possible
- Decide which foot and which part of that foot is required on that hold to make the next move
- Make a single movement to place the foot onto that hold and weight it fully. Hesitating and slapping the foot around the hold, or placing the foot onto the hold several times before weighting it will expend unnecessary energy, decrease confidence in the hold and probably lead to failure

- When fully weighted on the hold, make a conscious effort to push the foot into the hold – the greater the pressure the better to increase adhesion.
- Think of the whole body as a single entity, pushing weight down through the core, the legs and the feet into the hold. This is known as “The Kinetic Chain”.

Coaching Tech: Ideas for coaching foot placement precision

1. Targets:

- Slow Step** - traverse an easy line making each step slowly, first-time placement, visualise the hold-toe-leg as one, keep looking at the hold and push the toe into the hold before moving on it. Only then look towards the next hand hold.
- Accuracy Exercise** – touching a toe to a target on the wall: (1) From a standing position out on the floor. Increase the speed of doing it: slow to as fast as you feel comfortable. (2) Stand close to the wall and touch a toe to a hold to the side in the same manner.
- The Cork Traverse** – place corks on big holds and traverse on the holds without the corks falling off. This emphasises the need to continue to have full accurate control even when moving OFF the hold.

Positive Mental Preparation when using footholds:

- Be positive
- Focus on the sequence of: **hold – foot – leg**
- Trust your feet. Modern rock shoes are well designed for their purpose.
- Don’t rush the move, but make the decision and act on it.
- Stay relaxed



Coaching accurate control moving on and off a hold using the cork traverse tech!



1.5 Fundamental foot movement Techniques

Pivoting the Foot

One of the reasons that the toe area of the foot is used primarily when making moves in preference to the side or arch etc. is that the foot rarely remains stationary on a hold. It has to be able to be pivoted from side to side and up and down as we climb, whilst still being weighted as a functioning hold for our BoS.

Foot- Swap

Usually a climber will visualise mainly which handholds will be used during route-reading, and only note specific footholds from a distance. Most footholds are identified only a few (two) moves in advance on a larger climb. In addition, as the feet are the primary balance point, swapping feet will be used in many more situations than handholds as the moves have to be executed. Hence, swapping feet on single holds will happen regularly and the technique is vital.

Coaching Tech: Ideas for coaching better use of footholds

'Pivoting': Face-on to the wall, allow space between the toe and wall; twist the knee and heel sideways. Get used to it on different sized holds.

Foot Swap Methods:

1. **Hop.** Involves a 'bounce' as feet are swapped
2. **Tablecloth.** Just like a magician pulling a table cloth from under a set table, one foot is placed on top of the other, and the bottom foot slides out from underneath
3. **Smear.** One foot smears above the foot hold, and then both smear. This makes the foot hold 'free' for a foot to be placed on it
4. **Ankle twist.** The foot twists from side on to front on exposing part of the hold to be used by the other foot
5. **Roll.** The foot on the hold rolls up as the other one rolls down
6. **Match.** Often involves a step through as both feet temporarily share one foothold

1.5 Handholds

Rock surfaces are covered in holds. What you use for your hands may not be what you use for your feet! – depending on a variety of factors, but primarily on balance and movement requirements. In a climbing wall, where the routes are ‘designed’ this may not be the case. But of course there is always the wall surface to smear on. But some walls, especially modern bouldering walls, have non-frictional wall surfaces and so a coach can therefore design a problem or route which isolates a specific sequence of holds to force the climber to execute a specific movement.

The ability to decide quickly the most efficient way to use a handhold will optimise performance.

For handholds the following is true:



Size Matters:

When it comes to difficulty, in general, smaller hand holds means harder grades.

The Angle of Dangle:

What a hold ‘feels’ like to actually use alters depending on the steepness of the rock / wall. This may seem like common-sense, but awareness of this helps decision-making en-route. When climbing steep walls, more of the body weight is taken by the arms and so larger holds here ‘feel like’ smaller holds on off-vertical and slabby rock where most of the weight is being taken by the legs and feet, and the hands are mainly for balance. In other words a 5+ on a slab will have smaller holds than a 5+ on a steep wall.



The Forearms are Weak:

There are few muscles in the hand, just tendons and ligaments. These structures do not get ‘pumped’ or tired. The forearm muscles do all the ‘pulling’ and ‘gripping’ work and they get pumped. So, once the angle starts to steepen and the forearms take more of the body weight, greater arm-strength is required to maintain position.

Relax your grip:

"Over Gripping", either through fear (common to all climbers) or a lack of awareness (common to beginners), can mean the forearms pump quickly and failure (falling off!) is the usual result. Use minimum grip strength, even when hanging from a hold – whatever the angle, a conscious effort should be made to relax the forearms and prevent over-gripping. Concentrating on the forearm and controlling breathing to slow steady breaths can help.

NOTE: How tight a climber grips a hold is not the same as how hard he/she pulls on it to make a move. Always assess how hard you need to grip for any given situation. See the Coaching Tech advice on page 23.

Injury Prevention:

Crimping, placing the fingers into a tight-bent position (see BELOW) can place extreme forces on the ligaments and tendons of the fingers and leads to increased chance of injury. Open-handed grips (see BELOW) are far less likely to cause injury. So attempt to use an open-handed grip if at all possible - even on jugs!

Not all Jugs are the same:

On steep walls, where the body weight cannot be balanced onto the feet (placed over the Base of Support - see later), its best to get as much of the hand on the hold as possible.

Sharp-edged deep incut jugs can appear to be easier to grip than rounded shallow incut jugs (Figure1), but with the sharp incut the fingers are almost crimped (the fingers are held in a tight-bent position) and the body weight force is acting through a smaller surface area of the hand in contact with the hold, whereas the shallow incut jug presents a more open-handed grip and distributes the body weight force over a larger surface area of hand (Figure2). This spreads the force over a larger hand area and reduces the chance of injury, particularly in children.

To use a deep incut in this way as the angle steepens, lean back from the hold and engage a more open-handed grip (Figure3).

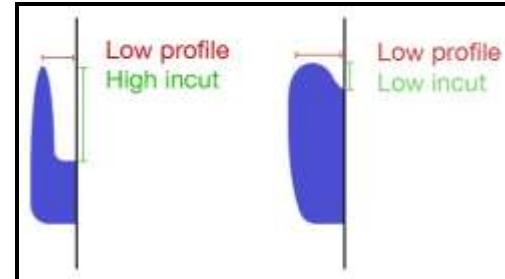


Figure1

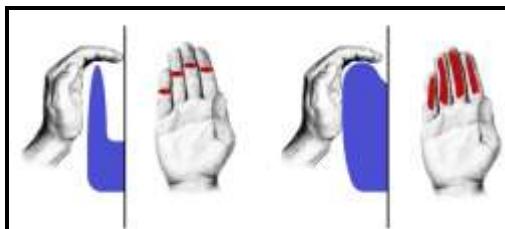


Figure2

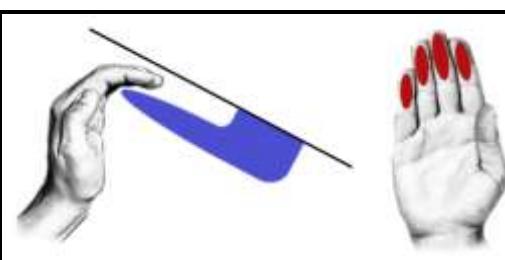


Figure3

Taken from: Jugs and Injury prevention
<http://routecrafting.blogspot.co.uk>

Techniques for different holds

Crimping

For holding small, usually sharp-edged holds, the ends of the fingers are placed facing down on the hold and when weighted, the fingers naturally form an inverted 'V'. This forces the first finger joint to supinate – bend backwards. This hold position places great stress on the finger ligaments, tendons and joints and is a primary source of injury. On the other hand, crimping can be very effective in gaining height from a hold.

The use of crimping should be developed slowly in children, starting with vertical walls and only moving on to steeper and steeper walls after strength has been built up. Children in particular should stay away from crimpy-set routes at climbing walls and should try and use open-handed technique whenever possible.

Full Crimp:

Uses the thumb either next to the fingers or actually over the top of the first two fingers. The thumb adds stability and additional strength.

Half Crimp:

same as the full crimp, but without the thumb over the top of the hold or fingers.



FULL CRIMP



HALF CRIMP

Open Handed

Basically the hand is held in an 'open' position best indicated when hanging down on a sloping hold. Open-handed techniques can be used on jugs (see above) and on smaller holds and it is the only method of using 'slopers'.



OPEN HANDED

Gastons

These are side-pulls that face the wrong way in relation to where the climber is placed. To use them as handholds means turning the hand thumb-down and pushing on them - away from the body. They require an opposing hand hold or foot hold pushing in the opposite direction to maintain a balanced position. Using gastons places the greatest force and strain on the fingers, hands, arms and shoulders of any technique.



GASTON

Fingers and Thumbs

You have a very useful opposable phalange (the thumb), so use it! Invariably a hold will have a side element to it which can be used by the thumb. There is even an account of a climb on St Kilda from the 1700's that involved mantle-shelving onto a thumb on a tiny triangular hold.

The Thumb Gaston

The thumb can be used instead of the fingers on difficult gastons, where it's hard to turn the hand thumb down to use them.

In other circumstances, the thumb can help stabilise a hold as follows:

The Thumb Sprag

The thumb opposes the fingers in a crack feature to give stability and security to the hold. It feels as if it adds strength to the hand and requires less effort from the arm during the move. Used either as a single move or even to make lay backing a crack more efficient.

Pinches

This is a grip position where the thumb and fingers grip either side of the hold like a vice. Like the thumb sprag, it adds stability but also increases the range of movement of the body around the hold as it is possible to make an outward pull on the hold as well as pull down or sideways on it.



THUMB GASTON



THUMB SPRAG



PINCH

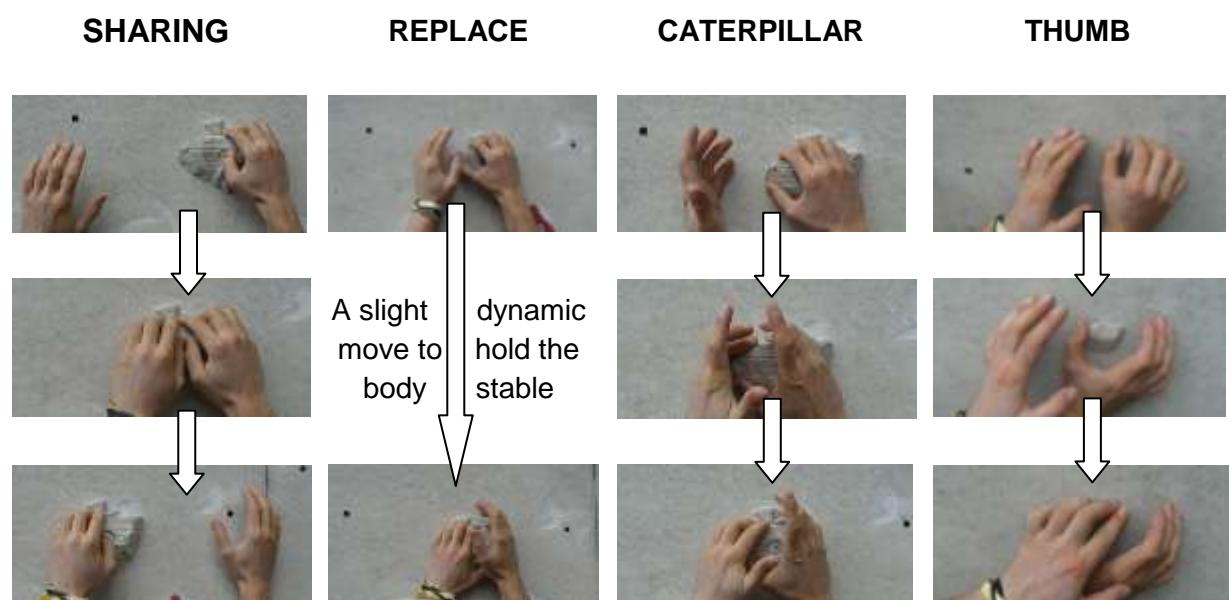
Coaching Tech: Ideas for coaching better use of hand holds

1. **Glue Hands:** reach for a hold and latch it. Without re-adjusting in any way, climb on it, as if it was then glued on – no re-adjusting for a better grip. Repeat on the same holds but concentrating on what part to aim for. Note the difference.
2. **Light Touch:** make a conscious effort to judge the grip used on a hold on a problem or climb. Judge the grip on a scale of 1-5 as follows: (1) **fully relaxed** – just touching the hold; (2) **light grip** – holding a cup of coffee; (3) **medium grip** – carrying a heavy bag; (4) **gripping hard** – hanging from a bar; (5) **over-gripping** – just being able to pull a very heavy box. Climb it at different grip levels starting at level 5 and descending and see how light a touch can be used for different steepness's of wall.

Hold-Swap

Despite attempts to visualise which holds will be used by which hands before embarking on a section of climb (known as route-reading) swapping hands on a hold will happen regularly for a variety of reasons:

- the route is ‘read’ wrongly,
- the orientation of the holds requires the same hand to reach again,
- you need to shake-out the arms from a single hold or you can’t cross-through the arms etc.



Coaching Tech: Ideas for coaching hand-swap

Sharing: plan ahead and if there is room, place the fingers of the leading hand over part of the hold. This leaves a section for the other hand to grasp, even if this requires only using 2 fingers.

Replacement: If balance allows, one hand can be removed completely whilst the other latches the hold, or if balance is off-set or the wall is overhanging, a small dynamic movement by the body may allow the hands to be changed at the deadpoint (requires good coordination).

Caterpillar Fingers: If the hold is small, the fingers can be removed and replaced one at a time.

1.6 Efficiency & Economy of Movement

The way you move encapsulates and governs your climbing style. The way you change shape and positions you adopt: ‘should I go with left or right hand, put my foot here or perhaps there?’. The choices you make, either consciously or subconsciously, determine your efficiency of movement. Some climbers seem to instinctively know the easier ways to climb and make a difficult route look easy. Moving efficiently requires a collection of skills and is probably one of the most difficult areas of climbing to master, not least because of the amount of thought it requires. The end product of efficient movement is to reduce the load on the hands. This can be achieved largely by avoiding technical errors as follows:

Technical Errors from the use of holds:

- Using the wrong part of the foot
- Imprecise foot placement
- Lack of awareness of the position of your centre of gravity
- Covering the entire foothold when it’s necessary to swap feet
- Clumsy foot swapping

Technical Errors from other areas:

The following technical errors combine with the above to reduce efficiency:

- Pace:
 - Poor route reading
 - Climbing too slowly
 - Climbing too quickly
- Body awareness:
 - Inability to use momentum effectively
 - **The most fundamental technical error is failing to place your centre of mass in the best position with regards to minimising the load on your arms.**

This aspect of Body Awareness in climbing is now investigated through Balance and Momentum:

1.7 Body Awareness

(BALANCE & MOMENTUM)

The following information about the underlying principles of what climbing movement constitutes supports the practical delivery of this element of the workshop. In order to do this an understanding of the effect of momentum on balance and the differences between static and dynamic climbing in climbing terms is introduced through **Body Awareness**. The workshop does not cover in detail the techniques of Swinging, Deadpointing, slapping and Dynoing, which are to be covered in an Advanced Techniques Workshop.

We have already explained in basic terms that economy of movement is achieved by moving the centre of gravity over the new foot position – called weight transfer – in the FUNdamentals of Climbing 1 Workshop and that a balanced position is one where the body's weight acting through the centre of gravity rests over the feet.

We shall investigate in more detail the idea of using this concept to make upward moves using the different body positions that will be dictated by the layout of holds. But first it is important to understand the effect that movement vertically has on the balance of the body and how that feels. This is best done by considering the basic movement of climbing a ladder as follows:

FUNDamental Kinaesthetics

Kinaesthetics is how we naturally perceive our body's orientation and movement. It is essentially how we 'feel' what is correct in any given physical position or movement. Consider the basics of climbing being similar to climbing a ladder. This involves:

1. All the climbers' weight is on the legs / feet.
2. The hands have a Light Grip.
3. One foot only is pushing at a time.
4. **The Left-Right Rule:** ascent is by an intuitive sequence of right and left rhythm: step-reach-step, pairing opposite hands and feet (i.e. pulling right hand & pushing left foot). This gives maximum stability and feels correct.
5. The body is held out from the ladder in an upright position.
6. The Centre of Gravity is always between the feet on the rungs of the ladder.



Left hand up,

Right leg up

➤ **The hips are the Centre of Gravity (CoG)**

➤ **The rungs are acting as the Base of Support (BoS).**

Balance:

Balance is defined as the relationship between the **Centre of Gravity** and the **Base of Support**.

There are three types of 'balance' applicable to climbing:

1. **Static**
2. **Offset**
3. **Dynamic**

Which type of balance is being actively utilised at any one moment is dependent principally on the size of the **Base of Support**.

Static Balance:

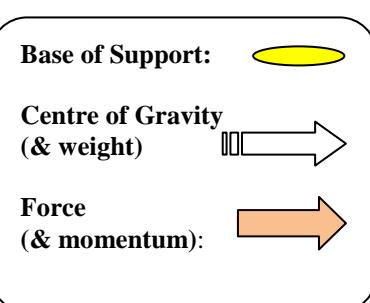
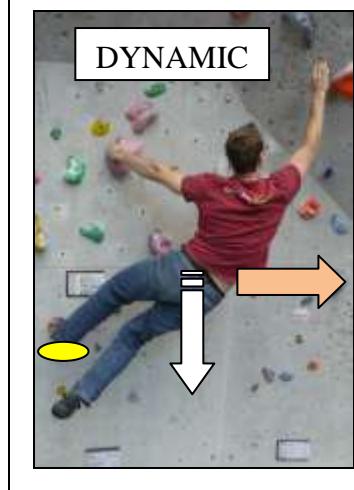
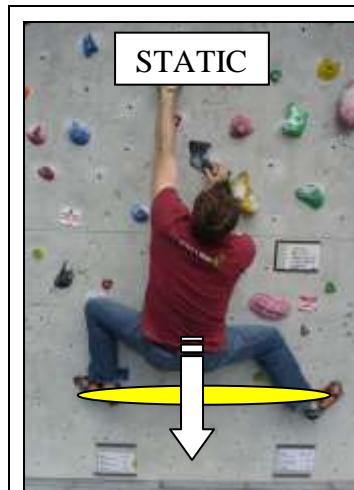
- The most stable balanced position
- Centre of Gravity is in the centre of the Base of Support
- Least effort to maintain

Offset Balance:

- It feels insecure
- Usually has a very small Base of Support
- Centre of Gravity is near the edge of the Base of Support
- Maintaining balance requires constant adjustment of body position

Dynamic Balance:

- This is NOT 'losing your balance', although it may appear to be! Nor is it dynoing!
- Centre of Gravity is outside the Base of Support
- The Centre of Gravity is forced to move until a new Base of Support allows static or offset balance to resume
- Requires less effort than off-set balance to perform



Base of Support

The BoS is the area a body is balancing in. To be statically balanced the centre of gravity must be directly over the BoS.

The Base of Support in a Horizontal Plane:

It's helpful to first look at this with a sport which is played out on a horizontal surface, like dance or gymnastic floor routines. A routine like headstands that have three points of contact (forming a triangle on the ground – the supporting surface) are easier to perform than a handstand, which has two points of contact (forming a slim linear shape on the ground), as it is easier to keep the CoG within the larger BoS area under static balance.

The same principle applies to climbing but is much more complex because:

1. We engage a vertical plane by using our hands
2. The angle of the supporting surface changes
3. The angle of our body to the vertical and to the surface changes constantly even during a move

The Base of Support in Climbing:

In climbing it is helpful to consider BoS in two planes.

The Horizontal Plane:

The BoS in the horizontal plane is the feet and their contact point with the climbing surface. However, this is virtually always closer to a handstand than a headstand, as the BoS (a small area between two feet) is always at the wall surface whilst the CoG (the hips) can be over or close to the edge of the BoS (on a slab) or beyond it (on a steeper wall).

The Vertical Plane:

In the vertical plane, the position of the hands will alter the BoS area which will vary depending on the angle of the wall as follows:

Slab: CoG (hip) is out from the wall above the feet (BoS). Making a move will entail pressing down (even if only slightly) on the hands as well as the feet and so the hands become part of the BoS. This enlarges the BoS considerably (like a Headstand) – both horizontal and vertical components are large. The body is in a static balanced position (see below).



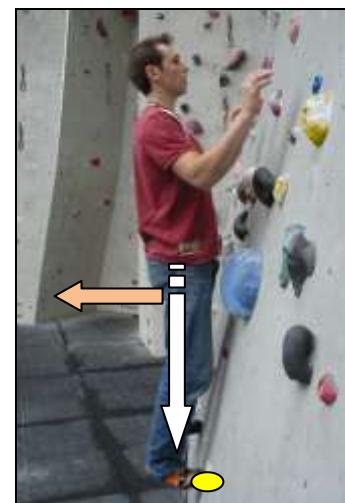
A Static Balance position
In the Horizontal Plane on a
Vertical wall, indicating
a 'Triangle' Base of
Support in the Vertical Plane



The CoG is inside the BoS (in to the wall) which forces the body to fall towards the slab and is therefore offset and out of balance

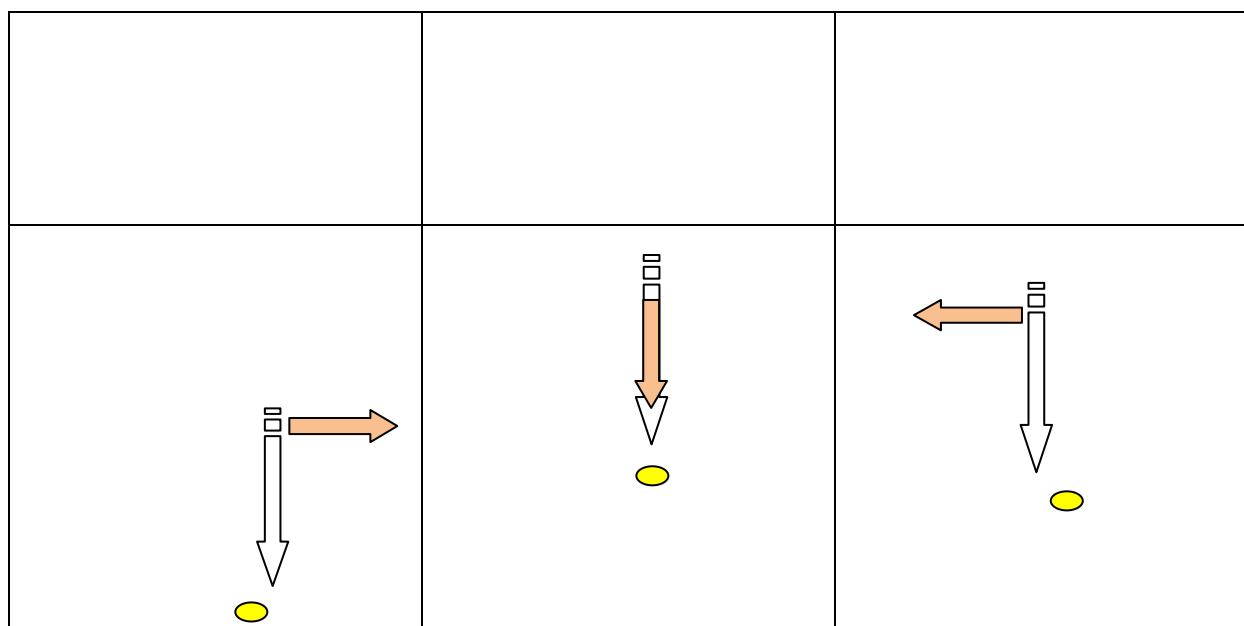


A static balanced position with the CoG directly over the BoS which means that handholds are not even required

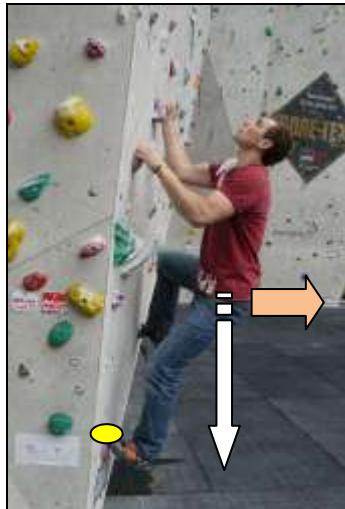


The CoG has just moved behind the BoS which is offset balance and creates a force to fall backwards

Vertical: CoG (hip) is close in to the wall above the feet (BoS). Some of the weight of the body is still acting through the hands, but much less than on a slab. The horizontal BoS is small and the vertical BoS is large. The body is in an offset balance position requiring constant correction to maintain balance. However, it is possible through good technique to gain a relatively static balance position on a vertical wall by moving the body into a position that puts the CoG more central to the BoS so that all the weight is through the feet and the hands can release the holds and gain a rest (see below).



Overhanging: CoG (hip) can only be outside the horizontal BoS. As the wall angle steepens away from the vertical, there is less and less body weight acting through the feet but more and more acting through the body via the handholds. In effect the horizontal BoS is reduced with gravity no longer acting on the body's weight through a supporting surface. Alternative climbing techniques (for the feet, body and hands) are then required to utilise the now predominant vertical BoS through the arms and feet. Think of the comparison to the gymnast who is now performing on parallel bars and rings.



On a slightly overhanging wall in the normal 'attack position' of a move, the CoG is always behind BoS. Moving upwards in this position requires more effort from the arms



Leaning the hips into the wall reduces the force pulling the body backwards and the straight arm technique demonstrated here allows a rest.



To make an upward move from this position, keeping the hips into the wall reduces the distance between CoG and BoS and reduces effort required from the arms

The Self Coached Climber by Dan Hague and Douglas Hunter explains this fully. See Bibliography.

Climbing Movement & Body Awareness

It's important for a climber to be aware of all the moving parts of their body – to fully understand their whole body Kinaesthetics – and how they affect movement in relation to CoG and BoS. Reviewing the CoG ideas in the FUNdamentals of Climbing 1, in relation to BoS we build a better picture of climbing movement as follows:

Static Balance

In a static balanced position (Centre of Gravity over the feet), the core area of the body must be between the two feet and tilting toward the wall to get the hips as close to a point above the feet as possible – in other words gaining a balance point in two directions of the horizontal plane: along the plane of the wall and at 90 degrees to it.

Movement

From this static balanced position, moving the body into another position to produce movement sideways (stepping up to a hold or traversing), entails moving the CoG outside the BoS, putting it off-balance – gravity creates a ‘force’ on the body which forces movement to take place until it regains balance. Allowing this force to move the body creates **momentum**. This movement is a dynamic movement.



Maintaining Position

Moving the body forwards (towards the rock) or backwards (out from the rock) has a similar effect of forcing the centre of gravity outside the horizontal BoS, with the former scenario placing emphasis on the legs and hips to act against the attendant force (e.g. on a slab and near vertical wall) and the latter placing greater emphasis on the arms, back and core to counteract the force (e.g. on an overhang) to simply hold the body in position.

Conclusion: The ‘Climbing’ Principle

Rather than the basic ‘Ladder principle’ of the Left-Right Rule, climbing occurs on more complex terrain and therefore can be considered as a series of repeated bouts of movement (a constant process of adjusting balance to make moves from hold to hold) between periods of static ‘rest’. However, the periods of movement can be termed as either ‘static’ or ‘offset’ (controlled by body position) or ‘dynamic’ (controlled by momentum) and the periods of rest may be true rests (e.g. hands-off and relaxed) but may equally only be resting part of the body (e.g. one arm).

Coaching Tech: Ideas for coaching body awareness

1. No-Handed Climbing: used to help novices identify the 3 different types of balance.

- (1) Choose a slab with a reasonable number of good footholds
- (2) Make fists or hold tennis balls in each hand and don't hook them over holds
- (3) Take small steps, and use a variety of sized foot holds
- (4) Experiment leaning in to the wall and out from the wall, bending the back and find the static balance point where CoG is above BoS.
- (5) Experiment leaning left and right to find off-set balance and identify which muscles are being used to maintain balance

1.1 Muscle Awareness: Now focus on body awareness:

- (1) Climber should shout out 'Press' when they feel a muscle being used
- (2) They then identify which muscles: pushing with legs, pulling in with toes, holding tension with core & back
- (3) Now get the climber to assess the degree of 'pressing' on each move. Repeat and alter the amount of pressing in each move
- (4) Repeat this time focusing on the end-point of the move & make sure you identify and use all muscles to hold your final position

2. Blind Climbing: Eliminating visual reference allows the climber to 'feel' what's happening to their body and their CoG during moves.

- (1) Choose a vertical wall with lots of large holds and a top-rope
- (2) Put on the blindfold and try a few moves to get used to the feeling
- (3) Climb up slowly, experimenting with a range of body movements: push left and right, in to the wall and out from the wall
- (4) Consider the pelvis and core/back positions, hip joint and pelvis orientation, arms straight or bent

2.1 Muscle Awareness: An extension to vertical and slightly overhanging to counter the bad habit of relaxing legs at static balance points and unnecessarily weighting arms

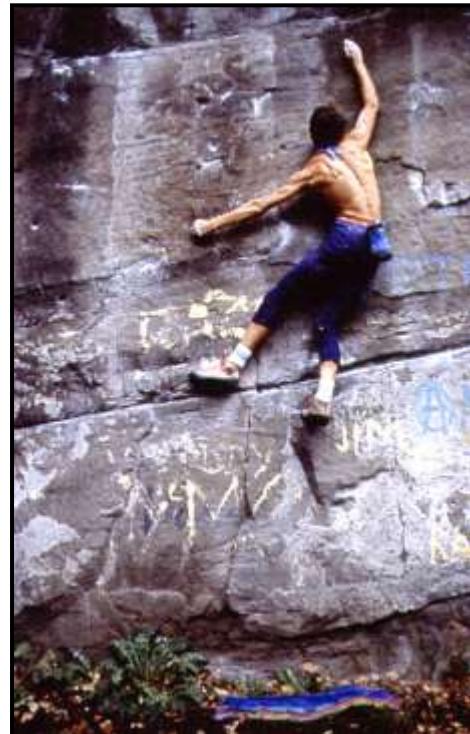
- (1) Climb a route 3 grades below limit that can be climbed with little effort, repeating the 'press' exercise as for the slab
- (2) Compare 'pressing' by legs and pulling by arms for each move and between each move
- (3) Reproduce the conscious awareness of using all the leg, core, back and shoulder muscles as the next hold is grasped

Static Climbing

To make a move (e.g. up onto higher footholds or to reach up to higher handholds) entails altering either or both the BoS (a foot) and an arm which forces the transferring of body weight as the move is undertaken. ‘Static’ climbing is when this process is achieved primarily by first aligning the feet and the body position to gain the best balanced position, allowing the arm movement to be made without the CoG moving outside the BoS.

This style of climbing movement is slow and ‘methodical’ and usually requires only one limb movement at a time in order to maintain a larger BoS – essentially, **the Ladder Principle & Left-Right Rule**. In most circumstances except slabs, the body position is controlled by the muscles and static climbing will require the expenditure of greater energy in the legs, core and also the arms. This is because under these circumstances the CoG will be on the edge of or outside the BoS as the move is executed and this offset balance position is being held for a longer period of time.

Hence, although it may appear to be more in control, it can be less efficient.



ABOVE: John ‘Spider’ Mackenzie at Wolf Crag Quarry in the early 1970’s when static climbing was the rage!

BETWEEN: Taking a swing on the Dumby Boulders

Dynamic Climbing

The alternative approach to climbing statically is to use the force created by the CoG being outside the BoS to ‘help’ complete the move. Instead of the body finding an additional force from the muscles to counteract the force pulling it out of balance, you can allow the momentum created by that force to execute the move.

Dynamic climbing is faster and more energy efficient, but requires greater levels of agility, flexibility and body awareness. Using momentum in this way allows a climber to reach a hold with less effort, and often further, than can be reached using a static movement.

Dynamic climbing is investigated in an Advanced Technique Workshop.



1.8 Foundation Techniques

There are two important techniques that should be mastered at an early stage, as soon as the novice climber has grasped the idea of centre of gravity and weight transfer. These simple techniques allow greater economy of movement, control of balance and weight transfer, and progression onto vertical and steeper ground where they are indispensable. They are:

- 1. Straight Arm**
- 2. Body Twist**

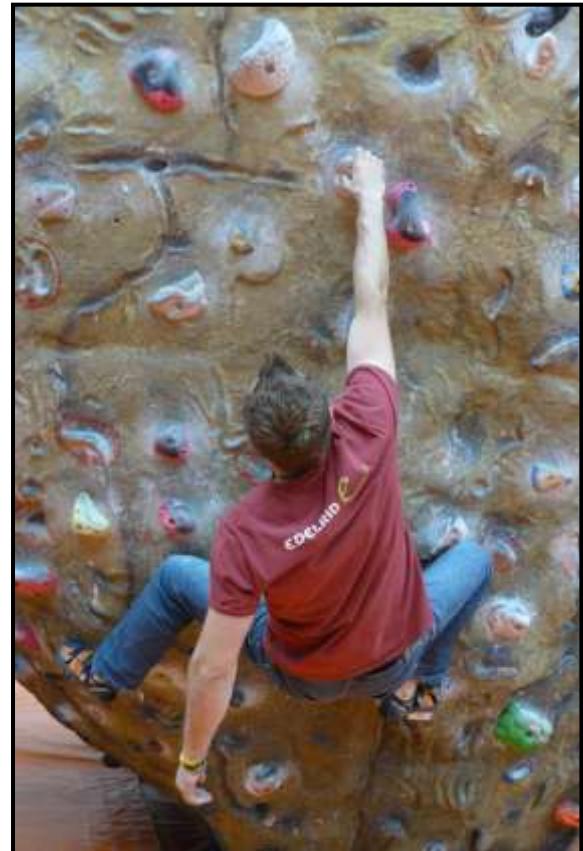


These two techniques are usually used together.

Straight Arm

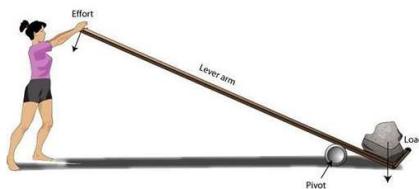
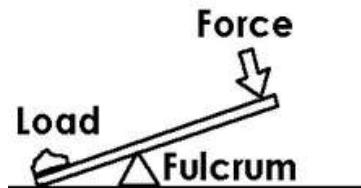
As the skeleton is stronger than the body's muscles, it makes sense to use their strength at every opportunity, and particularly with the arms, which are usually the first muscle group to fatigue. This can be demonstrated by:

The Monkey-Hang: when stationary and statically balanced on a vertical - overhanging wall with the feet a little beyond shoulder width, legs apart almost straight and the arms bent, holding the body upright, then the arms are using energy unnecessarily. Instead, keep the CoG low on the handhold by squatting down and hanging straight armed. Body weight is then being supported by the arm skeleton not the arm muscles and the difference is noticeable.



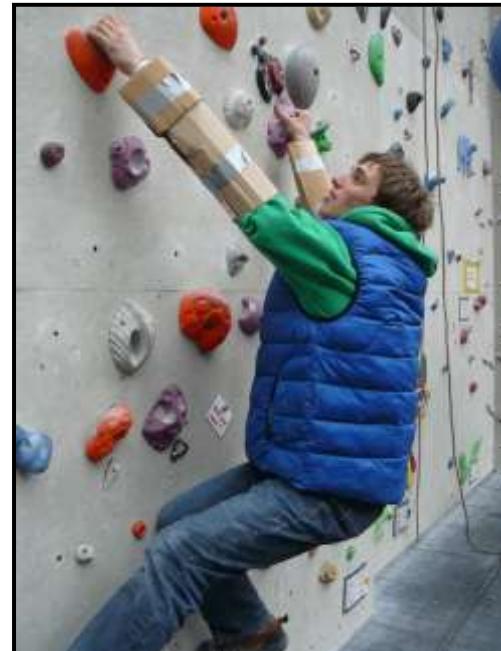
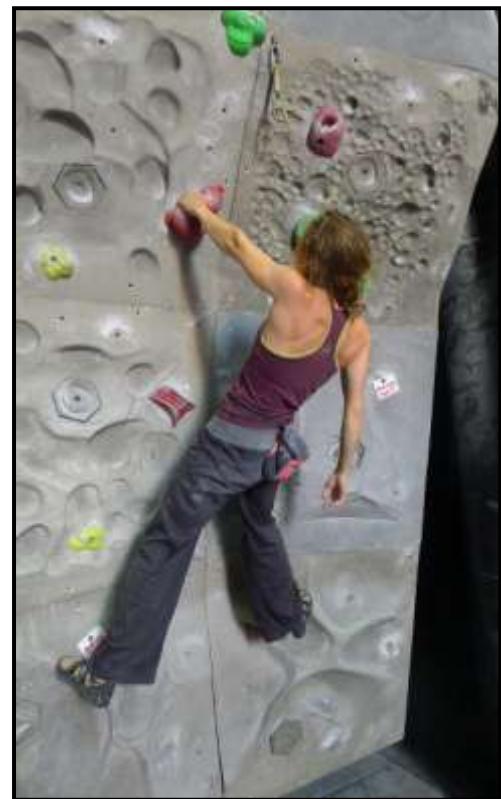
Straight Arm Biomechanics:

When making moves on steep walls, a straight arm can increase the 'Mechanical Advantage' (the efficiency) gained from a larger leverage offered by the shoulder joint rather than the elbow joint.



This occurs because of the principle of levers and the study of it in animals is known as Biomechanics. It's a complex subject but as far as we are concerned here, the elbow joint is a '**Third Class lever**' designed for producing speed and range of motion rather than force (it's good at throwing stones), so it will be more efficient to limit the use of the elbow as much as possible, especially when the legs cannot take the bulk of the body weight on overhanging walls. Keeping the elbow straight helps because:

- It transfers the lever fulcrum to the shoulder which is a better force-producing lever (although the shoulder is a complicated joint with many muscle group attachments and this is a simplified explanation)
- the ball and socket joint of the shoulder has a much larger range of movement
- it engages the bigger muscles of the shoulder, back, core and legs which reduces the amount of energy used by the arms and makes the move more efficient



TOP: Straight arm in a static balanced position

Bottom: Using cardboard boxed around the arms is a good way to illustrate the benefits of the technique

See **Appendix 2: Levers** for more explanation.

Body Twisting:

One of the main techniques to master for steeper rock is that of twisting the body position relative to the wall. This automatically initiates a selection of other techniques that can be used to reduce the amount of force necessary to make the next move. There are two elements to this technique: **Lower Body Twist** and **Upper Body Twist**.

Lower Body Twist:

Twisting the hips from a position parallel to the wall to a position at an angle to the wall gives several benefits:

- It is also sometimes called the ‘Twist Lock’ as it really does feel like your body is ‘locked’ into position and thus improves stability
- It brings the CoG (hips) closer to the base BoS (closer into the wall) in positions of off-set balance , placing more of the body weight onto the footholds
- It brings the body underneath the hand holds, changing the angle of the hands on the holds to make them feel more positive
- It reduces the amount of force required to maintain balance and move to the next hold
- It takes the forces off the smaller muscle groups of the forearm and off the fingers and transfers it to larger muscles in the core, back and legs
- It transfers the forces in the elbow joint to the shoulder joint which is better suited as a lever under higher loads for making the next move

Upper Body Twist

This is a twist of the shoulders out of alignment with the hips. In steep traverses this is not always necessary, but as soon as you are climbing upwards on steep walls and using drop-knees / Egyptians and flagging to make upward diagonal moves, then it is unavoidable. Its main function is to maintain a straight arm during the move.





Coaching Tech: Ideas for coaching Body Twist

Turning Exercise: stand face-in to the wall, toes touching the wall and attempt to squat down without moving the knees sideways. Your bum moves out from the wall, forcing the CoG to move away from the BoS and eventually the force pulls you over. Now stand 90 degrees to the wall with one hip touching it. Now squat down and back up using the arms either side for balance. This movement should feel easy.

'Backwards Traversing': choose a vertical wall. Keep the body at 90 degrees to the wall, toes pointing in the opposite direction to travel, one hip in toward the wall. Traverse both directions.

- Make a note of which hand feels easier to move.
- Moving left: Left hip in – the left arm should feel more natural
- Moving right: Right hip in – the right hand should feel more natural

Switch Back-Traversing: this is the same as the Backwards Traversing exercise, but making a hip twist between moves alternating between left and right hip at the same time as moving in one direction

- Move the correct hand for the relevant hip (left hip, left arm etc.)
- Keep the arms straight above the head
- Pivot the feet on the footholds on each move
- Note how the inside leg knee drops a little on each move (drop knee)

1.9 Climbing Steep Terrain



Most novice climbers progressing to steep terrain (vertical and overhanging) would consider it as more strenuous and therefore require greater arm strength. However, steep wall and roof climbing in most instances at the FUNdamental stage of climbing mainly requires additional climbing techniques rather than strength.

The main issue concerns the CoG positioning in relation to the BoS and the techniques of using different hip and ankle positions which result in differing degrees of body twist, and these are considered in the FUNdamentals of Climbing 2 Workshop.

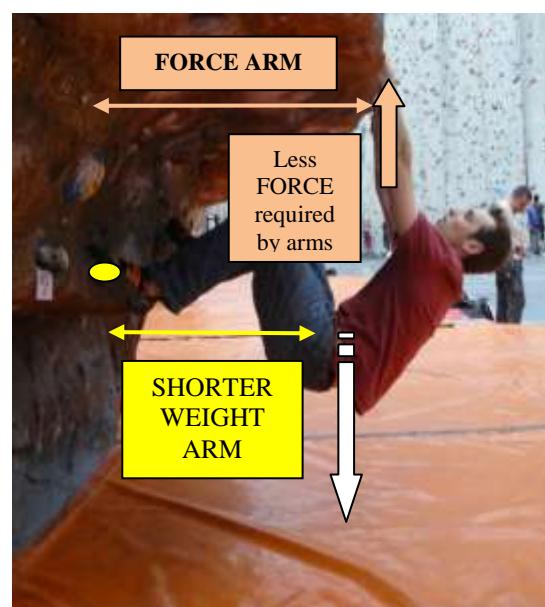
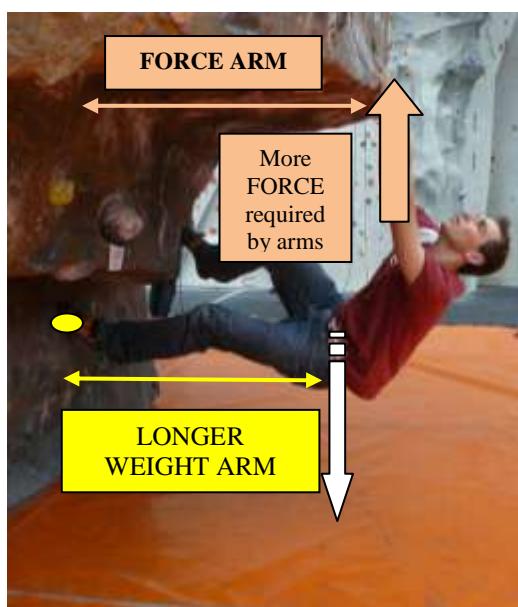
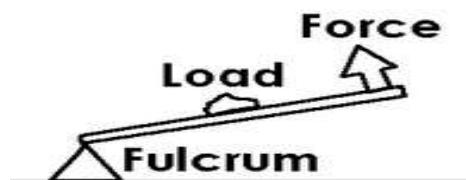
What's Different on Overhanging Walls?

To recap: on overhanging walls there is less and less body weight acting through the feet and more and more acting through the body via the handholds because the CoG (hip) is outside the horizontal BoS. As we know the arms contain the weakest muscle group, we have to find alternative techniques to redress this imbalance and get more weight back onto the legs.

To understand how to do this, it helps to know a little about the biomechanics of climbing overhanging rock...

Consider hanging straight-on to an overhanging wall with all arms and feet on the wall. Consider the body position as acting as a lever. The feet are the fulcrum against the wall, the weight is the body weight acting through the CoG at the hips and the force counteracting the weight comes from our arms acting through the handholds (refer to the Appendix on levers).

Hanging on the wall in this position creates a 2nd Class Lever system. This gives the opportunity to create a mechanical advantage, which can be used to generate more force. This is achieved by altering the relative distances of the Force Arm (the toe to hand distance) and Weight (or Load) Arm (the toe to hip distance): the amount of force required from the arms to either stay stationary or to overcome the weight of gravity to make the next move, can be reduced by reducing the Weight Arm – the distance between the weight (hips) and the fulcrum (feet), which makes the move easier.



All the following techniques have this same objective – to reduce the effort required through the arms to make a move:

Steep Rock Techniques

Back Stepping

This is simply placing a foot on a hold behind you, whilst in the twist lock position. It feels like it happens almost automatically when initiating a lower body twist, as the inside leg bends. But to make a move off this twist position usually requires the inside leg to be either directly below the hip CoG or below the torso and slightly behind you and may require re-positioning. The outside leg can be placed on any suitable foothold to help maintain the twist lock. Both feet must push together as the holding arm (usually kept as straight as possible) pulls the body further into the wall.

The twist lock and the back step together are a very stable combination for climbing steep walls.



Flagging [1], Back Stepping [2], Lower Body Twisting [3] & Upper Body Twisting [4] & Straight Arm [5] are all being used to climb the competition wall at Ratho

Coaching Tech: Further ideas for coaching Twisting

Switch-back Ascending: this is the same as the Switch-back Traversing exercise, but in order to climb upwards you must:

- Exaggerate the twist
- Exaggerate the drop-knee
- Have precision of foot placement
- Twist the shoulders more to enable a straight arm

Flagging (Counter-Balance)

When hands and feet are not following the Ladder Principle's Left-Right Rule (i.e. the move entails performing a left-hand-left-foot, or right-hand-right-foot sequence) the BoS is tiny (one toe position) and off-set balance is hard to maintain. Moving off this position without regaining some balance will cause a rotational force. The feeling is one of 'Barn-Dooring' to the side. The easiest way to regain balance is to put the other foot out to the side against the wall. It does not require a foothold, nor pressure against the wall. This counter balances the barn-door effect and is called 'Flagging'.

You can flag a leg inside the other leg, outside the other leg or even in a back-step.

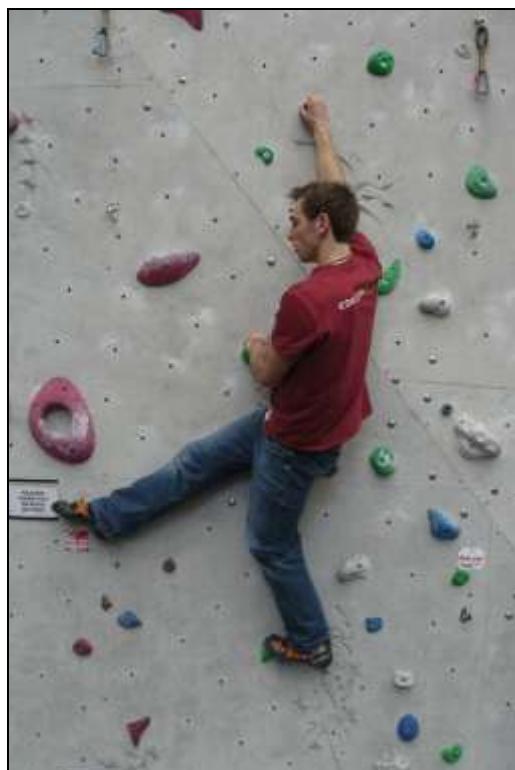
Inside Flagging: best when the foothold is low in relation to the handhold, better stability as CoG is closer to the wall as it forces a lower body twist, gives greater possible reach and so is used for making moves and is good for stabilising moves through roofs

Outside Flagging: best when the foothold is high close to the handhold, can force the CoG further from the wall and does not entail a body twist so is less stable, less reach is possible so is used often to maintain a static position

Back-Step Flagging: more difficult to understand when it can be used, when in a twist-lock back step position, when handholds and foothold are close together, with no other foothold and the target hold is a long reach away, flagging the outside foot helps counter balance the move



OUTSIDE FLAG



INSIDE FLAG

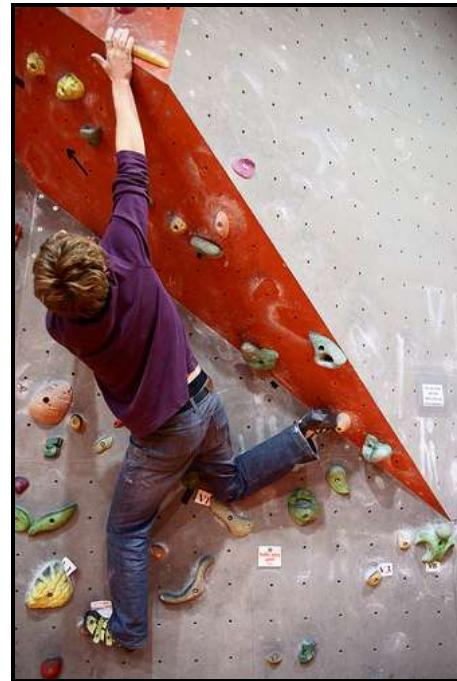
Egyptian (Drop Knee)

Principally this is a ‘bridging’ move that is most useful for making upward moves on steeply overhanging walls, which would otherwise entail very powerful pulls with the arms in an off-set or dynamic balance position. This technique combines the twist lock of the hips and the principle of the flag, but using a foothold to help produce stable balance for the move by:

- Widening the BoS (by forming a bridge)
- Lowering the CoG
- Twist locking the hips into the wall
- Using the dropped foot to ‘pull’ the body into the wall – like a third handhold!

The Egyptian usually starts from a position hanging straight on to the wall with horizontal handholds. A foot is brought up to a hold close to the under the bum (although it can also be used on a hold a little off to the side as well – which is harder). The toe is pivoted to bring the knee in towards the body and then ‘drop kneed’ down lower than the foothold. The hip automatically twists as this is undertaken. Pushing hard on both feet locks the body in position.

Egyptians are best on steep walls with more side-way oriented footholds. They are least effective on vertical walls with horizontal crimps.



Coaching Tech: Ideas for coaching the Egyptian

Exaggerated Squatting: Use the drop knee and twist lock in a more and more squat position, i.e. start with arms and legs slightly extended, then becoming more and more ‘crunched up’ with each attempt, until both legs are almost horizontal to the hips.

Exaggerate the movements:

- Exaggerate the hip twist the more crunched you become
- Exaggerate the drop-knee the more crunched you become
- Exaggerate the pressure through the foot placements by additional kinetic chain tension

2. Static stretching to increase flexibility & reduce injury

Introduction

In the FUNdamentals of Climbing 1 Workshop the idea of warming up as a vital part of a climbing routine was introduced. This involved gentle aerobic activity, joint rotation and easy climbing entailing gentle dynamic stretching of muscles, tendons and ligaments. The Workshop also introduced ‘flexibility’ as one of the Key Principles of climbing. Dynamic stretching is not a means of increasing the range of movement of joints (i.e. increasing ‘flexibility’) but used during a warm-up to prevent injury and aid performance. We also introduced some simple static stretches important to climbing that can be used during cooling down that help recovery.

However, at some stage, as the frequency of climbing and the incentive to climb harder increases, there will develop a requirement to increase flexibility and this will usually be undertaken by static stretching. Such exercises are best regarded as stand-alone from climbing (like gym work for developing strength).

The FUNdamentals of Climbing 2 Workshop does not specifically cover this item, and this section of the Resource Pack should be taken as additional information. It will help to offer advice on cool-down routines at the end of climbing sessions that help develop flexibility.



A Dynamic Stretch of the shoulder to warm up muscles and joints: quite different to a Static Stretch which enhances the range of motion of the joint

Why Stretch?

Climbing requires virtually every muscle in the body to contract as we make a complex series of movements. The most obvious are muscles in the **arms** to make our limbs bend at the joints, for example to extend to reach holds and to pull on those holds; and the muscles of the **legs** which extend the legs to reach holds or stepping up onto holds and then pushing down on them. There are also the **core** muscles around the waist / hip area of the body, which come into play when we twist, lean sideways, backwards etc. and which gives stability to the spine. The positions under which these muscles must operate can be at the extreme limits of the joint's range.

Look at some key facts about muscles:

- Muscles can only contract
- To move a joint in both its directions requires two opposite-acting muscles on the same joint
- There is usually one main muscle (or a group of muscles) that is predominant in a sport (e.g. the forearm or bicep in the arms for climbing)
- The opposite-acting muscles to the main ones used in a sport are known as 'antagonistic' muscles and create the opposite movement, usually to return the joint back after a move, but usually not under as great a load
- A muscle gains strength from being placed under repeated load, so the main muscles used in climbing will have greater gains than the opposite-acting muscles
- Muscles can be over-stretched by their opposing muscles but not by themselves
- Muscles that are not stretched as part of a routine feel 'tight' leading to reduced healing ability, reduced ability to gain strength, increased tiredness and reduced range of movement

“Stretching ‘Antagonist Muscles’ is important to reduce injury”

Regular stretching helps increase **flexibility** (i.e. the range of movement of the joints) and ensures muscles are at their maximum length.

If a climber has good **flexibility** then the muscles are less likely to be damaged when operating through their extreme range.

Increased **flexibility** has been shown to help climbing success by enabling greater use of technique, particularly regarding hip flexibility to allow greater use of the lower body and legs.



Types of Stretching for Flexibility

Static Stretches: the climber simply stretches the muscle or muscle group to the extreme limit of its extension without assistance and holds it for a short time.

Passive Stretches: This is a static stretch in which an external force (such as the floor or another person) holds the performer in the static position.

Active Stretches: Active stretching uses both agonist and antagonist muscles in one action. An example is doing high kicks with the leg. There is more potential for muscle tears and soreness and it is not considered appropriate for FUNdamentals of Climbing.

Development Stretches: Development stretching is used to increase flexibility in areas of need such as hamstrings and hip flexors. The stretch is taken to the point of tension, held for a few seconds, then when the tension eases, stretched a little further. It is not considered appropriate for novices at FUNdamentals of Climbing level to use this type of stretching.

Reminder on Stretching Do's:

Correct: undertake a sustained stretch whilst remaining relaxed

Incorrect: bouncing up and down against the muscle and stretching to the point of pain

1. Undertake the usual warm-up routine (warm muscles stretch more easily and safely), including some very easy climbing
2. Hold the stretch constant (with only a feeling of mild discomfort)
3. Try to remain relaxed during stretching
4. Keep the hold-time under 10 seconds during initial stretching
5. Once fully warmed up and after preparatory stretching engage stretches for 20+seconds
6. Use a full range of stretches in the routine
7. Stretching after climbing is possibly more important: after exercise the muscles are more susceptible to stretching gains
8. Don't use the stretches that cause injury (see Contra-indicated Exercises in the FUNdamentals of Climbing 1 Resource Pack)

Climbing Muscle Stretches:

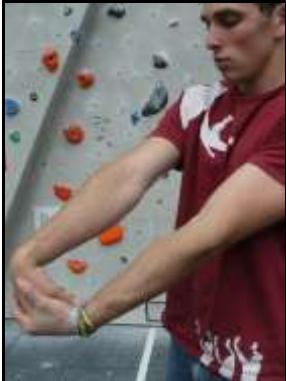
(Information supplied by Theresa Tait MTI ACMT BA Dip
<http://www.theresatait.com>)



Obviously climbers need to stretch those muscles most engaged in climbing and will concentrate on the arms and shoulders, but as most of the bodies muscles will be engaged in some way due to the complex nature of climbing, stretching most of the muscles in the body is important: Here is a selection:

Basic Static Stretches for Novice Climbers:

The following static stretches may be used with novice climbers after a climbing session to aid recovery, reduce muscle soreness and help reduce the incidence of injury:

Forearm (Fingers)			
		<p>These are the muscles that enable grip. Perform with the stretched arm thumb pointing out (as here) and again pointing in, helping to prevent <i>Golfers Elbow</i>.</p>	
Flexors			
	<p>The muscles at the back of the arm (climbing antagonists): their strength & flexibility help prevent <i>Tennis Elbow</i>. Keep the hand clenched into a fist (thumb out).</p>	<p>Also perform in a thumb up and thumb down position.</p>	
Extensors			

Upper Arm (& Shoulder)	
	Targets the Triceps but also a mild stretch of the shoulder. Try to touch between the shoulder blades and grab the elbow with the other arm and pull to the back of the head.

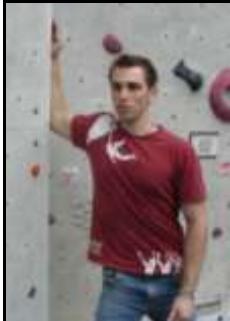
Triceps

Upper Arm (& Shoulder)	
	The palm of the hand should be flat; the upper body is turned away from the arm until the stretch is felt in the bicep: the predominant muscles used in pulling on steep terrain.

Biceps

Shoulder	
	This targets the Supraspinatus and Rhomboids and Posterior Deltoid muscles of the shoulder and upper back used on vertical and overhanging climbs.

Supraspinatus

Chest	
	Targets the Pectoralis Major muscles in the chest as well as the Anterior Deltoid muscles of the back. Keep the palm flat and turn the upper body away from the arm.

Pectoralis Major

Posture (& Chest)	
	Keeping shoulders relaxed, chin horizontal, 'open' the chest and stand 'tall' by engaging the back and core muscles. Opens the chest and pulls the shoulders down to prevent lumbar curvature.

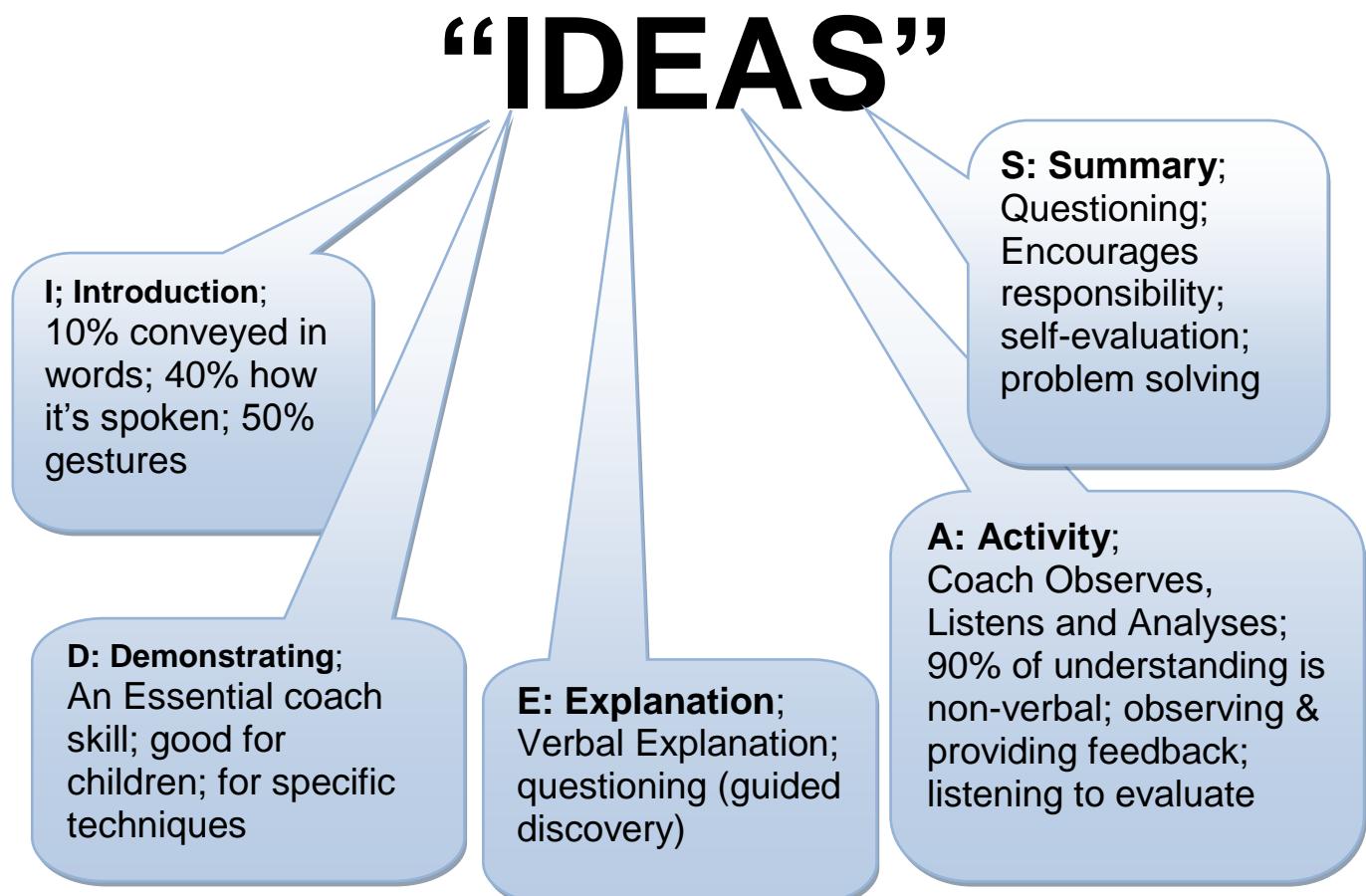
Posture (& Chest)	
	The coach can help gain the best posture for any individual by simply imagining the front of the shirt is a handle and gently pulling upwards to signify what to do.

Legs	
	Raise the foot to waist level onto the wall without assistance, keeping the knee straight, balance and hold.
Hamstring	
Upper Legs	
	The thigh muscle which is used in all step-up moves in climbing, particularly on slabs. Keep the legs together and the knee pointing down, held by the hand; and pull the foot towards the back for extra stretch.
Quadriceps	
Legs & Hip	
	The muscles round the hip joint are complex and aid flexibility in all climbing moves. This helps stretch these muscles including the Tensor Fasciae Latae.
Abductors	
Legs (Calf Muscles)	
	Calf muscles are involved in standing on tip toes, which is a key element of climbing. Intensify the stretch by placing toes towards the edge of the step. Also engages the Soleus muscle known as the '2 nd heart'.
Gastrocnemius	
Back	
	These muscles keep you upright and are used when twisting left or right and reaching. Latisimus Dorsi (Back) are also engaged when sitting back on the heels
Spinea Erectors	
Hip	
	Several muscles round the hip are engaged in virtually every climbing move. Stretch these with the leg behind the body and an upright stance - pushing the pelvis forward
Upper leg & hip	

3. Coaching Process

Reviewing Skills

Building on the Coaching advice in FUNdamentals of Climbing 1, there is a simple acronym used in reviewing a session that can help focus the coach and the clients. It is known as:



4. Bibliography

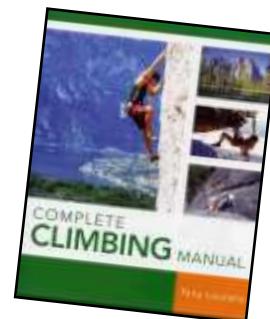
General Subject Matter:

The following general climbing or mountaineering books contain some chapters on climbing technique.

The Complete Climbing Manual

By Tony Lourens; Published by New Holland 2005

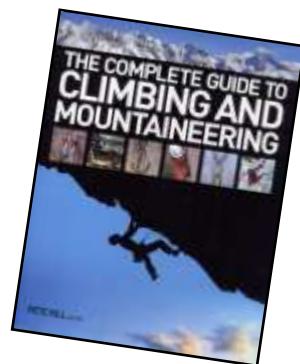
Chapter 4: Essential Skills and Technique. Contains basic information about body positioning, slab, face and crack climbing techniques, and as an American book it contains a lot on off-width techniques and American names for techniques.



The Complete Guide to Climbing & Mountaineering

By Pete Hill; Published by David & Charles 2008

Chapter 3: Movement, Bouldering and Climbing Walls. A short section covers different handholds, footholds and specific techniques such as lay-backing.



Rock Climbing

Introduction to Essential technical Skills for Leaders and Seconds

By Pete Hill; Published by Cicerone 2007

Chapter 6: Moving on Rock. An extensive chapter covering basic information about handhold, footholds, climbing specific types of rock angle and formation.



Coaching Subject Matter:

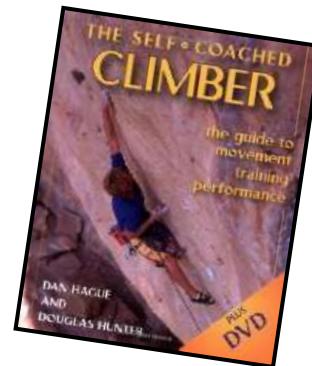
The following books contain descriptions of coaching principles of 'How To' undertake the techniques for climbing.

The Self Coached Climber

A guide to: movement training performance

By Dan Hague and Douglas Hunter 2006

This is the Bible for a climbing coach!



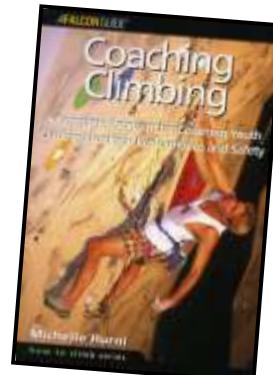
The most informative book yet on the mechanics and theory as well as the coaching of climbing movement. The first 6 chapters give detailed information about balance in most climbing situations with clear diagrams and explanation. Detail on how to establish Body Awareness, the Base of Support, hand and feet positioning, dynamic and stable positions and controlling force. Plus a DVD!

Coaching Climbing

A Programme for Coaching Youth Climbing for High Performance and Safety

By Michelle Hurni; A Falcon Guide 2003

Chapter on techniques but also much more on 'how' to coach these techniques than most other books on the subject – a 'must read'.

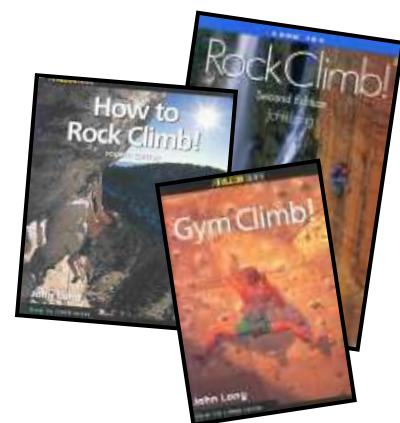


How to Rock Climb! 2nd Edition

By John Long; Published by Globe Piquot Press 2003

Chapter 2: Face Climbing Skills & Chapter 3: Crack Climbing Skills. Still a great book for introductory coaching in climbing technique.

Also available: Advanced Rock Climbing 1997, Gym Climb! 1994



How to Climb Harder

A Practical Manual

By Mark Reeves; Published by Pesda Press 2010

Starts off with coaching information about how we learn, followed by a progressive series of movement exercises to help 'learn' the techniques. Also training advice is included.

The Pesda website includes all the illustrations from the book available as downloads (free) for use in presentations!

<http://www.pesdapress.com>

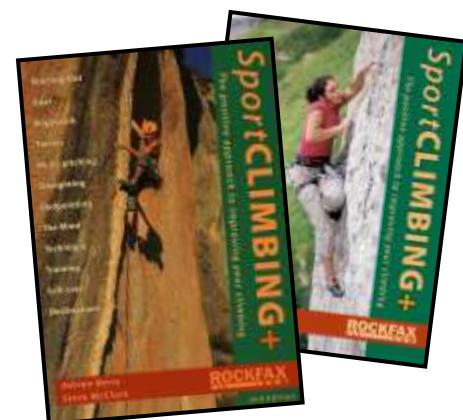


SportCLIMBING+

The Positive Approach to Improving your Climbing 2nd Edition

By Adrian Berry and Steve McClure; Published by RockFax 2006

Chapters on Tactics and Techniques which has helpful information on pre-climb stretching, and good information backed up with photos and diagrams on balance and body position.



TradCLIMBING+

The Positive Approach to Improving your Climbing

By Adrian Berry and John Arran; Published by RockFax 2007

Chapter on technique focusing outdoors on rock features but covering all the same movement techniques as that of SportCLIMBING+ but in a traditional setting.



5. Web-based Information:

The following websites contain climbing technique and coaching information:

The On-Line Coach

<http://onlineclimbingcoach.blogspot.co.uk>

Dave MacLeod's coaching blog.

Climbing Coach

<http://climbingcoach.blogspot.co.uk>

<http://icoachclimbing.com/>

Mark Reeves blog and App site

The Self Coached Climber

www.selfcoachedclimber.com

Dan Hague's forum with lots of views and ideas.

Masterclass Coaching Academy

www.masterclasscoachingacademy.com

Neil Gresham's coaching scheme

Training for Climbing

www.trainingforclimbing.com

Eric Horst's website with expansive articles and research papers



Somatotype and Morphology Papers:

1. BAYIOS, I.A. et al. (2006) Anthropometric, body composition and somatotype differences of Greek elite female basketball, volleyball and handball players. MD.J Sports Med Phys Fitness. 46 (2), p. 271-80
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12. BLAKEY, P. (1992) The Muscle Book. UK; Bibiotek Books Ltd.

APPENDIX 1

Rock Shoe Design and Function

Getting the correct rock shoe that suits the individual is not easy, especially when there are so many makes and designs on the market and such a huge price range. Hence, this crash course in rock shoe design will help coaches give advice.

Rock Shoes

1. Shape

- a. Design and function
- b. Fitting

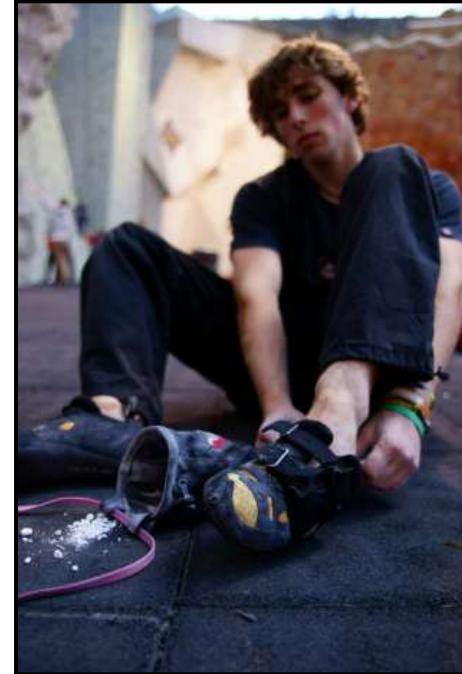
2. Friction

- a. What is 'sticky rubber'
- b. What are the limitations of rock shoes' friction

Rock shoe design has evolved dramatically over the past ten years. The shape and construction of a rock shoe today is determined by its intended use. There is now a range of shoe designs which cater for different types of climbing; *trad, sport, big mountain wall, etc.* Designs are also specific for different types of rock: *steep pocketed limestone, vertical cliffs with predominantly sharp edged holds or slabs* where holds are small and friction more important.

The design differences to make style-specific rock shoes include different degrees of sole stiffening (length and width), heel design, asymmetric or symmetric toe shapes, 'hardness' of the rubber, defined 'edges', low-cut or higher-cut ankle support – the list goes on!

And of course everyone's feet are different and because a rock shoe must fit snuggly it must cater for a variety of foot shapes. There are actually 3 distinct recognised shapes and the shoe's symmetry will make a difference to what's best on a personal level, regardless of the required performance.



Anatomy of a Rock Shoe

1. Mid-sole: Located between the foot-bed and the sticky-rubber outsole, the mid-sole helps determine the shoe's stiffness. Materials and dimensions vary from full-length leather to ultra-thin composites that reinforce the toe box.

2. Uppers: The material above the rubber rand: leather, synthetic, or a combination. Leather is comfortable but tends to stretch. Synthetic tends to keep its shape which may be a benefit for precision footwork, but not for comfort.

3. Heel Cup: Most heel cups are rubber-coated for improved heel hooking.

4. Rand: A strip of rubber that surrounds the shoe between the sole and the upper. It folds underneath the shoe to provide a surface to which the sole is glued.

5. Toe Box: Most toe boxes are designed to focus the climber's weight onto the big toe.

6. Sole: Comprised of sticky rubber, generally covering from toe to heel.



Design features

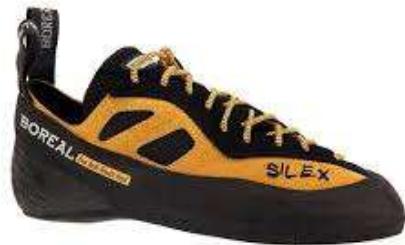
The shoe is built around a base called a 'Last'. This dictates what the shoe shape, foot-bed size and profile will be. There are two main items to consider:

- **Shoe profile:** There are 2 aspects of a shoe profile that can both vary, termed 'Mild', 'Moderate', or 'Aggressive':
 - The side to side profile: the extent of the asymmetric shape (displacement) towards the big toe (the left-to-right symmetry)
 - The heel to toe profile – the vertical 'camber' Generally speaking lasts vary from flat, mildly asymmetrical to pronounced, aggressively down turned
- **Sole Stiffness:** the 'mid-sole' dictates either support (stiffer, more durable with added protection) or sensitivity (thin mid-sole that is very flexible and allows a 'feel the rock' sensation)

So what shoe fits what climber?

Beginner Climber: Climbing mainly slab to vertical routes, in balanced positions so spending a significant period of time on the feet.

- *Requirements:* A comfortable fit; a stiff sole offering foot support for all-day use; support for toes when standing on edges.
- *Best Shoe Design:* A ‘Mild’ profile, both vertically (a flatter sole) and sideways (a more natural toe-box); a stiff mid-sole (offering greater support); and a greater volume toe box.



Intermediate Climber: Climbing technical face routes to slightly overhanging routes.

- *Requirements:* a sensitive shoe to offer good feedback from foot placements, yet on technical face routes a stiff enough mid-sole to edge with. Feet will be reasonably strong in Intermediate climbers and so will benefit from a softer mid-sole, and a snug toe-box fit.
- *Best Shoe Design:* A ‘Moderate’ design for all-round climbing but also excelling in overhanging terrain. Down-pointing cambers make edging and smearing difficult so a moderate last offers a performance fit and a mildly stiff midsole for precision, edging and smearing.



Advanced Climber: Climbing mainly upside down!

- *Requirements:* Climbing steep / overhanging routes requires the foot to curl the toe down in an attempt to pull the body into the rock as well as gain some power from the feet.
- *Best Shoe Design:* A pronounced camber is ideal for steep routes and so an ‘Aggressive’ shoe is best. Strong foot muscles that are not growing means heel-cups that push toes into the aggressively asymmetrical toe-box designs are useful. The extreme example would be an aggressive slipper without a mid-sole for additional sensitivity.



Friction

One of the biggest developments in climbing shoe design in the past 20 years was the incorporation of a rubber compound that has very high frictional properties termed 'sticky'. This rubber is now used in many sports shoes including mountain biking and trail shoes. The rubber is affected by the ambient air temperature (and the temperature of the rock) and is at its stickiest when the temperature is relatively cool (about 4 degrees Celsius). However, they have their limitations and do not show appreciably increased friction on rock surfaces such as slate or on indoor wall surfaces that are only painted and not covered in a frictional surface.



However, the friction afforded by these shoes can make a huge difference on the size of the holds that can be used. On indoor walls and on rock types such as sandstone, anywhere on the surface can be deemed a hold under certain circumstances. The key to making best use of the friction is in the way the foot is held against the hold / surface: the angle of the foot against the wall / hold, the amount of shoe sole against the surface; the amount of pressure applied through the leg, and the use of opposing pressure from the other foot.

TOP TIPS for choosing your first Rock Shoes

Rock Shoes Will Stretch: All rock shoes stretch, but mostly in width, not in length. Shoes with rubber rands don't stretch much at all. If your toes are cramped and painful don't buy them.

Variable Sizing: Rock shoes come in US, UK, and European sizing, which makes size comparisons difficult. Try on lots of different makes of shoes in person in a shop and wear them for at least five minutes. Some shops have small walls where you can test them.

Buying On-Line: Great deals are available from on-line stores, but be aware that you may not pick the correct size! Make sure you can send them back unused for a size exchange.

Buying Used: UKC and other climbing websites, shops and climbing walls have bulletin boards selling 2nd hand rock shoes. Great deals are also found on E-Bay but beware the sizing issue.

Buying Last Year's Models: Look for the year's models being discounted in shops in the late winter and spring when are passé and heavily: particularly useful for really big or small sizes.

Podiatry Considerations for Children:

Although there are specialist rock shoes on the market in small sizes for children, it is important that a coach gives advice that helps them find a rock shoe that they can wear for long periods without damaging any potential growth of the foot. Aggressive asymmetric designs may cause serious podiatry growth issues and wearing specialist shoes will not increase a young climber's ability more than getting the techniques correct.

Getting a fit that is comfortable is the most important issue. The fit must be tight enough so there is no movement of the foot in the shoe, particularly side-ways, but not tight enough to constrict the toes. Heel shapes that are severely cupped (usually on 'Aggressive' shoe designs) push the toes into the front and can cause damage to the Achilles tendon and should be avoided. A natural foot-shaped asymmetric toe is best. The challenge is to find a shoe that firstly kids would like enough to wear (!) and then secondly be accommodating enough for their growing feet.

A good example is the Evolve Venga shoe. The Venga is easy to get on and off, designed to grow with the child as his/her feet grow and to be comfortable enough to wear for the entire climbing session.

1. **Last Shape-** is comfortable for most, if not all foot shapes. It is asymmetrical in toe profile and medium in foot volume.
2. **Velcro Closure-** It has an overlapping Velcro closure to help control the volume of the shoe depending on the foot's girth. It opens wide for ease of entry and wraps around, comfortably hugging the foot once closed.
3. **Elastic-** The elastic bands running underneath the ankles allows for a wider range of the opening for easy entry.
4. **Velcro Strap-** This adjustable feature tightens-up for a snug fit when the child is small and accommodates the lengthening of the foot as the child grows.
5. **No Mid-Sole-** A mid-sole is a support/chassis layer of a climbing shoe, useful for long climbs where more weight placed upon the feet. The Venga is designed for use on shorter climbs where weight is not an issue but more sensitivity is so it has no mid-sole.



APPENDIX 2

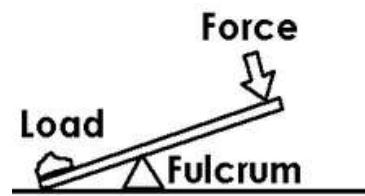
The Principle of Levers & Biomechanics:

- ❖ Why is it less strenuous to keep my arm straight doing moves on steep walls?
- ❖ Why does it help me rest if I squat down onto my footholds?
- ❖ Why does it make moves easier if I pull my body into an overhanging wall?

To understand why these techniques work, it's worth having some basic understanding of the physics of the human body. This means looking at how the body's limbs operate as lever systems. The study of it in animals is known as Biomechanics. It's a complex subject and this is only a brief introduction...

A 'lever system' comprises:

- A **force** applied
- An **opposing force (the Load)** such as a weight
- A pivot point, or **fulcrum** of the action

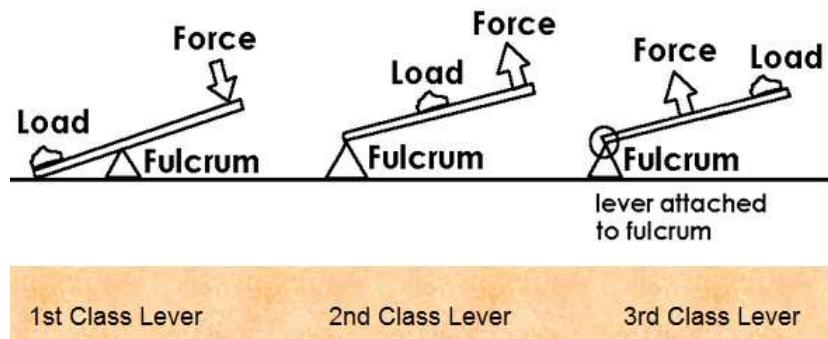


The distances between the different parts of the system are very important:

- ❖ The **force arm** is the distance from the fulcrum to the point where force is applied.
- ❖ The **load arm** is the distance from the fulcrum to the centre of gravity of the weight.

'Lever systems' are classified as:

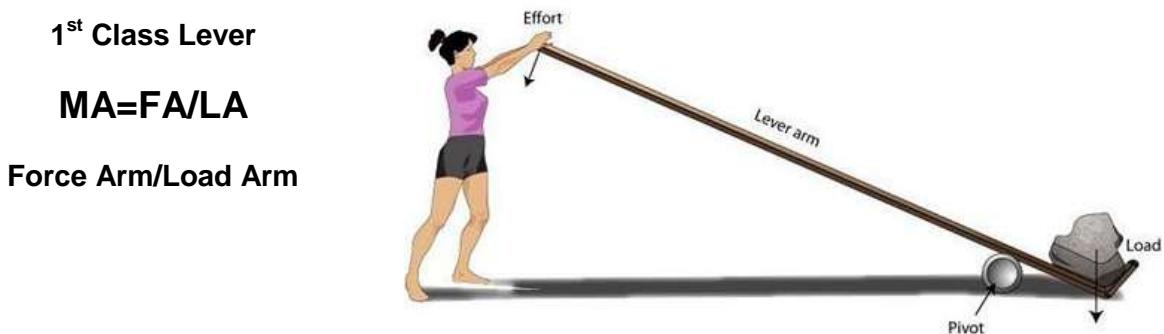
Levers are classified according to the relative positions of the **fulcrum**, **force** and **load**.



What's Mechanical Advantage?

The Mechanical Advantage is the efficiency of the lever system. It refers to the amount of Force that has to be applied to achieve a movement of the Load. This is dependent on the type of lever, but also the **force arm** (the distance from the fulcrum to the point where force is applied) and the **load arm** (the distance from the fulcrum to the centre of gravity of the weight).

A good example is a 1st Class Lever, where the Force Arm ('FA' or 'Lever Arm' in the diagram) is longer than the Load Arm ('LA' between the pivot and the load) and as a result, it takes a smaller force to lift a much higher load – this is a Mechanical Advantage (MA).



A **1st Class Lever** can have a mechanical advantage less than, equal to, OR greater than one, depending on the locations of the force and load in relation to the pivot.

A **2nd Class Lever** will always have a mechanical advantage greater than one because the force arm is always GREATER than the load arm.

A **3rd Class Lever** will always have a mechanical advantage less than one because the force arm is always LESS than the load arm.

Mechanical Advantage vs. Speed

The mechanical advantage of a 3rd Class Lever is poor – always less than one.

However, the SPEED of rotation created by a 3rd Class Lever is high because the load is located farther from the axis than the origin of the force moving it: it must travel a greater distance in the same time and greater distance per unit time = greater speed.

The opposite is true of 2nd Class Lever – produces greater mechanical advantage.

A 1st Class Lever can produce a mechanical advantage.

Biomechanics:

When making moves on steep walls, a straight arm can increase the '*Mechanical Advantage*' (the efficiency) of the lever system, gained from a larger leverage offered by the shoulder joint rather than the elbow joint. This reduces the effort required.

It also engages the bigger muscles of the shoulder, back, core and legs acting through the skeleton of the arm. As the muscles of the arm are not engaged in pulling the body up, this reduces the amount of energy used in these weaker muscles.

This occurs because of the principle of levers.

In the Body the bones, and the joints connecting them, are essentially a system of lever arms and fulcrums, moved by the muscles. The joints are **fulcrums**, the bones they connect are **levers**, the muscles attached to them apply **force** (sometimes referred to as the resistance – or the 'effort' you make) and the **load** is the weight of the climber.

The majority of the body's joints and muscles are designed in such a way to give as large a range of movement, and as much speed as possible, for as little force as possible, rather than for the production of force itself. These are 3rd Class Levers.

The elbow is a good example of this:

- **The elbow Joint** acts as the pivot (or **fulcrum**)
- **The lower arm (Ulna & Radius) Bones** acts as the **lever**
- **The Biceps Brachii Muscles** provide the **force** to move **loads** held in the hand
- Whilst climbing the **Load** is the weight of the **body**



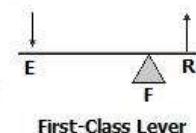
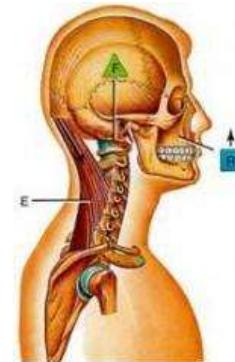
Illustration courtesy The University of Waikato, New Zealand

There are very few 1st Class or 2nd Class Levers in the human body – we are principally designed for fast movement rather than production of force to climb. However, we can use what 2nd and 1st Class Lever systems do exist to best advantage, and use technique to place our bodies into positions that create a mechanical advantage.

Examples of 'lever systems' in the body:

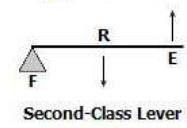
First Class Lever: nodding

- The fulcrum is between the force and the weight.
- They give the advantage of strength or speed depending on where the fulcrum is located
- Examples are a crowbar and the joint between the **skull and vertebrae** of the spine:



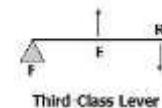
Second Class Lever: standing on tip toes

- The weight is between the fulcrum and the force
- They give the advantage of strength
- A smaller effort can be used to advantage over a larger weight
- Example is a wheelbarrow and the **Achilles tendon**, pushing or pulling across the heel of the foot



Third Class Lever: lifting a weight

- The force is located between the fulcrum and the weight
- They give the advantage of speed of movement
- Force is NOT increased: a larger force is required to move a smaller weight, so there is a force disadvantage
- Examples are the inside door handle of a car, finger-nail clippers, and tweezers
- Most of the movements of the body are produced by third class levers such as the **Elbow joint**



Appendix 3

Glossary of Types of Hold:

Jugs		Slopers	
Large holds that can be easily gripped often with the full hand and the fingers wrapped right over the top as if holding onto a bar.		Holds that are sloping downwards and have nothing to 'hook' your fingers over.	
Edges / Crimps		Pockets	
Usually small holds that have a sharp edge to them and only the first joint of the fingers can hold them.		Holes in the rock surface that usually allow finger tips only (1-2 digits deep). They can vary in size from allowing one finger to several fingers to be used.	
Wraps / Guppies / Mould		Presses / Palming	
Holds that you wrap your hand around. These can often offer respite during a climb as they rest the fingers more than you would think!		Any part of the climbing surface can be used as a 'press' where the whole palm of the hand is used to press down onto the rock.	
Side pulls		Flakes	
'Vertical' holds that face sideways and have to be grasped usually with the thumb pointing upwards, forcing the body away to the side of the hold – a 'layaway'. Correct body position and balance is important to be able to use these holds.		Larger side-ways facing holds that force a laying away action like a side-pull, but for usually more than a few moves up the flake.	

Jams Usually vertical cracks or vertical slots. An open hand can be inserted, then attempted to form a closed hand or fist until the sides of the crack meet the sides of the hand. Maintaining pressure maintains the jam.		Arêtes The reverse of a corner – a feature on the wall that looks like a corner turned inside-out. It can be a 90 degree arête (as pictured) or more or less angled. Layaway moves are required.	
Undercuts 'Up-side-down' holds: holds with the gripping part in the underside and the hands grip them palm-upwards.			Undercuts can be large (upside-down jugs) or very small (upside-down crimps). They all give the opportunity for increasing vertical reach and can be invaluable climbing through roofs.
Pinches Holds that have to be pinched between fingers and thumb to be securely held. They vary from single finger-tip holds to continuous limestone 'Tufas'.			
Gastons Side-ways facing holds that force a pressing action against the hold rather than a laying away action.			Usually gastons are held thumbs-down and allow movement away from the hold