

INTRODUCTION TO ATHLETICS.

Throughout this course various basic contents will be taught to introduce the comprehensive sport of Athletics. After a brief introduction and the exposition of the basic concepts of the warm up, the following sessions will cover flat races (emphasizing in the starting blocks), relays, hurdle races, long jump and shot put.

In each of the athletics events covered, we will outline the most relevant regulations in force. Also a detailed analysis of the ideal technique and its variants will be done, with a pedagogical progression model for its acquisition, focused mainly on the initiation and the school context. In subsequent courses the rest of the athletics will be covered, from a point of view closer to the high performance.

The main bibliography of the course will be the “**Manual Didáctico del Atletismo**” written by Ballesteros, the former Athletics professor in the INEF of Madrid. Additional bibliography, related to the specific topics covered, can be found at the end of the notes.

Any mistake or error that can be found, or any point that is difficult to understand while reading the notes should be exposed to the professor, in order to make the appropriate changes in later editions.

1.- ATHLETICS OVERVIEW.

Athletics is to Ballesteros (1992), the physical activity consisting of natural actions, done by men and women in various forms since the origin of species, such as running, jumping and throwing.

Already in classical antiquity, athletics takes the form of a regulated activity, and over the years it has evolved and its program been modified, becoming a sport that encompasses such different events, that the morphology and physical characteristics of the ideal athlete are very different from one discipline to another (for example, throwers compared to distance runners).

Athletics is the basic sport par excellence, for the tradition, its universality, the prestige and the wide range of skills and qualities required for its practice. Therefore, in the Olympic Games it is one of the most important sports. It is practiced throughout the world for its high educational value and how it improves the physical condition, being the basis of physical preparation for the rest of the sports.

At certain times, even today, athletics, like other sports, has been used as a political weapon and as an example of a country's development.

Besides how useful it is to stay fit and improve in sports, athletics is a sport open to experimentation and research that serves to verify, thanks to progress in the marks and times, the progress of human being. Many branches of science deal with the study of this sport.

2.- ATHLETICS PROGRAMME.

The athletic programme is composed of:

- Track events: Races (Flat and with hurdles).
- Field events: Throws and jumps.
- Race walking.
- Combined events.

Competitions are distributed normally in two sub-seasons.

1st.- INDOORS AND CROSS COUNTRY, OR WINTER SEASON: (November 1st to March 31st)

In the indoor track sprints, races up to 3000 metres and contests are performed, while the long distance races are outdoors, on grass or dirt tracks. Some middle distance runners start this season competing in cross country, switching to the indoor racing at the end of this season. In recent years, short cross country races are being scheduled, with distances of approximately half of the normal cross country length, mainly to facilitate winter training of the middle distance runners (see Figures 1,2, and 3).

2nd.- OUTDOORS OR SUMMER SEASON: (From April the 1st to October the 31st)

It has always been the most important racing season, but due to the emphasis in recent years in the indoor season and the cross country, the training programmes have gone from a single macro-cycle (with the ultimate goal in the summer season) to have two, smaller and with the main goals placed in March and in July and August (Spanish championship, and either European, World's or Olympic championship). (See Figures 4 and 5).

September and October are months without excessive scheduled competitions, and the ones programmed for this time are often of lower quality (amateur, tributes, etcetera), because athletes are, if not on vacation, at least in its basic stage of preparation.



Figures 1 through 5 show the athletic programmes determined by the RFEA for the 2011-12 season Indoor and Outdoor races, as well as the recommendations of distances for cross-country races in the different months of the season.

The Competition Rules of the IAAF (rules 261-264) recognizes, however, World Records only in some events (see Figure 6 and 7).

HOMBRES										
MESES	ABSOL.	PROMESA	JÚNIOR	JUVENIL	CADETE	INFANTIL	ALEVÍN	BENJAMÍN	CORTO	VET
Noviembre	9.000	9.000	6.000	5.000	4.000	2.500	1.500		4.000	4.000
Diciembre	10.000	10.000	6.500	5.500	4.500	3.000	2.000	Entre	4.000	5.000
Enero	11.000	10.000	7.000	6.000	5.000	3.500	2.500	1.000	4.000	6.000
Febrero	12.000	10.000	7.500	6.000	5.500	4.000	3.000	y	4.000	7.000
Marzo	12.000	11.000	8.000	6.000	6.000	4.500	3.500	2.000m	4.000	8.000
MUJERES										
MESES	ABSOL.	PROMESA	JÚNIOR	JUVENIL	CADETE	INFANTIL	ALEVÍN	BENJAMÍN	CORTO	VET
Noviembre	8.000	6.000	4.000	3.000	1.900	1.100	800		4.000	4.000
Diciembre	8.000	6.500	4.500	3.500	2.500	1.400	1.100	Entre	4.000	4.500
Enero	8.000	7.000	5.000	4.000	3.100	1.700	1.400	1.000 y	4.000	5.000
Febrero	8.000	7.500	5.500	4.000	3.700	2.000	1.700	2.000m	4.000	5.500
Marzo	8.500	8.000	6.000	4.000	4.000	2.500	2.000		4.000	6.000

Figure 1.- Recommended distances for cross country. Season 2011-2012.

INTRODUCTION TO ATHLETICS & WARM UP

 Manuel Sillero Quintana, M^a del Mar Arroyaga Crespo & Diego Martín Martín

Figure 2. - Men's events Indoor. Season 2011-2012.

	Sénior (89 hasta Veteranos)	Promesa (90, 91 y 92)	Júnior (93 y 94)	Juvenil (95 y 96)	Cadete (97 y 98)	Infantil (99 y 00)	Alevín (01 y 02)	Benjamín (2003/2004)
Carreras	60	60	60	60	60	60	60	50
	200	200	200	200	—	—	—	—
	400	400	400	400	300	—	—	—
Vallas	1.500	1.500	1.500	1.500	1.000	1.000	1.000	1.000
	3.000	3.000	3.000	3.000	3.000	2.000	—	—
	60 (1,067)	60 (1,067)	60 (0,990)(*)	60 (0,914)**	60 (0,914)	60 (0,84)	—	—
Saltos	Altura	Altura	Altura	Altura	Altura	Altura	Altura	Altura
	Longitud	Longitud	Longitud	Pérfiga	Pérfiga	Pérfiga	Pérfiga	—
	Triple	Triple	Triple	Longitud	Longitud	Longitud	Longitud	Longitud
Lanzam.	Pérfiga	Pérfiga	Pérfiga	Triple	Triple	Triple (*)	—	—
	Peso (7,280)	Peso (7,280)	Peso (6kg)(*)	Peso (5 kg)	Peso (4 kg)	Peso (3 kg)	Peso (2 kg)	Peso (2 kg)
	Hepthation	Hepthation	Hepthation	Hepthation	Exathion	Pentathlon	Triathlon	Triathlon
Pruebas Combinadas	Longitud	Longitud	Longitud	Longitud	Longitud	Longitud	Longitud	Longitud
	Peso (7,280)	Peso (7,280)	Peso (6kg)	Peso	Peso	Peso	Peso	Peso
	Altura	Altura	Altura	Altura	Altura	Altura	Altura	Altura
Pruebas Combinadas	60 v.	60 v.	60 v.	60 v.	60 v.	60 v.	60 v.	60 v.
	Pérfiga	Pérfiga	Pérfiga	Pérfiga	1.000	—	—	—
	1.000	1.000	1.000	1.000	—	—	—	—

(*) Los atletas junior están autorizados a participar en la prueba de 60m.v.(1,067) y lanzar con el peso de 7,280 kg.

(**) Carrera máxima 15m.

(***) Los atletas juveniles están autorizados a participar en la prueba de 60m.v.(1,00).

NOTA: Para las categorías Infantil, Alevín y Benjamín, también se recomienda realizar pruebas según guía de la RFEA "Jugando al Atletismo", Circular 128-2004

	Sénior (89 hasta veterana)	Promesa (90, 91 y 92)	Júnior (93 y 94)	Juvenil (95 y 96)	Cadete (97 y 98)	Infantil (99 y 00)	Alevín (01 y 02)	Benjamín (03 / 04)
Carreras	60	60	60	60	60	60	60	50
	200	200	200	200	—	—	—	—
	400	400	400	400	300	—	—	—
Vallas	1.500	1.500	1.500	1.500	1.000	1.000	1.000	1.000
	3.000	3.000	3.000	3.000	3.000	2.000	—	—
	60 (0,84)	60 (0,84)	60 (0,84)	60 (0,762)**	60 (0,762)	60 (0,762)	—	—
Saltos	Altura	Altura	Altura	Altura	Altura	Altura	Altura	Altura
	Longitud	Longitud	Longitud	Longitud	Longitud	Longitud	Longitud	Longitud
	Triple	Triple	Triple	Triple	Triple	Triple *	—	—
Lanzam.	Pérfiga	Pérfiga	Pérfiga	Pérfiga	Pérfiga	Pérfiga	Pérfiga	—
	Peso (4 kg)	Peso (4 kg)	Peso (4 kg)	Peso (4 kg)	Peso (3 kg)	Peso (3 kg)	Peso (2 kg)	Peso (2 kg)
	Pentathlon	Pentathlon	Pentathlon	Pentathlon	Pentathlon	Tetathlon	Triathlon	Triathlon
Pruebas Combinadas	60 v	60 v	60 v	60 v	60 v	60 v	60	50
	Altura	Altura	Altura	Altura	Altura	Peso	Longitud	Longitud
	Peso (4 k)	Peso (4 k)	Peso (4 k)	Peso (3k)	Peso	Longitud	Peso	Peso
Pruebas Combinadas	Longitud	Longitud	Longitud	Longitud	Longitud	60	—	—
	800	800	800	800	600	—	—	—
	—	—	—	—	—	—	—	—

(*) Carrera máxima 15m. (**) Autorizados con las vallas de 0,84 (***) Autorizadas con Peso 4kg durante temporada 2011-2012

Figure 3. - Women's events Indoor. Season 2011-2012.
MUJERES

También se recomienda realizar pruebas según Guía de la RFEA, JUGANDO AL ATLETISMO (Circular 128/2004) y libro del mismo nombre editado por la RFEA (septiembre 2004).



INTRODUCTION TO ATHLETICS & WARM UP

Manuel Sillero Quintana, M^a del Mar Arroyaga Crespo & Diego Martín Martín



También se recomienda realizar pruebas según Guía de la RFEA, JUGANDO AL ATLETISMO (Circular 128/2004) y libro del mismo nombre editado por la RFEA (septiembre 2004).

HOMBRES

	Sénior	Promesa	Júnior	Juvenil	Cadete	Infantil	Alevín	Benjamín
Lisos	100	100	100	100	100	80	60	50
	200	200	200	200	300	150		
	400	400	400	400	600	500	500	500
	800	800	800	800	1.000	1.000	1.000	1.000
	1.500	1.500	1.500	1.500	3.000	3.000	2.000	2.000
	5.000	5.000	5.000	5.000				
	10.000	10.000	10.000	10.000				
	Maratón 1/2 Maratón	Maratón 1/2 Maratón	Maratón 1/2 Maratón	Maratón 1/2 Maratón				
Vallas	110 (1,067) 400 (0,914) 3.000 obs.	110 (1,067) 400 (0,914) 3.000 obs.	110 (0,990)(****) 400 (0,914) 3.000 obs.	110 (0,914)** 400(0,84) 2.000 obs.(0,914)	100 (0,91) 300 (0,84) 1.500 obs. (0,762)	80 (0,84) 220 (0,76) 1.000 obs (0,762)		
	Altura Longitud Pértiga Triple	Altura Longitud Pértiga Triple	Altura Longitud Pértiga Triple	Altura Longitud Pértiga Triple	Altura Longitud Pértiga Triple	Altura Longitud Pértiga Triple (*)	Altura Longitud Pértiga	Altura Longitud
Lanzam.	Peso (7,260) Disco (2 kg.) Jabalina (800 gr.) Martillo (7,260)	Peso (7,260) Disco (2 kg.) Jabalina (800 gr.) Martillo (7,260)	Peso (6 kg)(****) Disco (1,750 kg)(****) Jabalina (800 gr) Martillo (6 kg)(****)	Peso (5 kg.) Disco (1,5 kg.) Jabalina (700) Martillo (5 kg.)	Peso (4 kg.) Disco (1 kg.) Jabalina (600) Martillo (4 kg.)	Peso (3 kg.) Disco (800 gr.) Jabalina (500) Martillo (3 kg.)	Peso (2 kg.) Disco (600gr) Jabalina (400gr) Martillo (2 kg.)	Peso (2kg.) Disco (600 gr) Pelota (200 gr) Martillo (2 kg.)
	4 x 100 4 x 400	4 x 100 4 x 400	4 x 100 4 x 400	4 x 100 4 x 400	4 x 100 4 x 300	4 x 80	4 x 60	4 x 50
Marcha	20 km. 50 km.	20 km. 50 km.	10 km. 20 km.	5 km. 10 km.	5 km. 10 km.	3 km. 5 km.	2 km. 3 km.	2 km. 3 km.
	Decathlon 100 Longitud Peso Altura 400	Decathlon 100 Longitud Peso Altura 400	Decathlon 100 Longitud Peso (6 kg.) Altura 400	Octathlon 100 Longitud Peso 400	Heptathlon 100 Longitud Peso Altura	Exathlon 80 Longitud Peso	Triathlon 60 Longitud Peso	Triathlon 50 Longitud Peso
	110 v. Disco Pértiga Jabalina 1.500	110 v. Disco Pértiga Jabalina 1.500	110 v. (0,99) Disco (1,750 kg) Pértiga Jabalina 1.500	110 v. Altura Jabalina 1.000	100 v. Jabalina 1000	80 v. Altura Jabalina		

(*) Carrera máxima 15m.
(**) Autorizados con la valla de 0,99.
(***) Autorizados a lanzar con los artefactos de los senior.
(****) Autorizados a competir con las vallas de los senior.

Figure 4.- Men's events Outdoor. Season 2011-2012.

También se recomienda realizar pruebas según Guía de la RFEA, JUGANDO AL ATLETISMO (Circular 128/2004) y libro del mismo nombre editado por la RFEA (septiembre 2004).

MUJERES

	Sénior	Promesa	Júnior	Juvenil	Cadete	Infantil	Alevín	Benjamín
Lisos	100	100	100	100	100	80	60	50
	200	200	200	200	300	150		
	400	400	400	400	600	500	500	500
	800	800	800	800	1.000	1.000	1.000	1.000
	1.500	1.500	1.500	1.500	3.000	3.000	2.000	2.000
	3.000	3.000	3.000	3.000				
	5.000	5.000	5.000	5.000				
	10.000 1/2 Marathon Marathon	10.000 1/2 Marathon Marathon	10.000 1/2 Marathon Marathon	10.000 1/2 Marathon Marathon				
Vallas	100 (0,84) 400 (0,762) 3.000m Obst. (0,762)	100 (0,84) 400 (0,762) 3.000m Obst. (0,762)	100 (0,84) 400 (0,762) 3.000m Obst. (0,762)	100 (0,762) (**) 400 (0,762) 2000m Obst.(0,762)	100 (0,762) 300 (0,762) 1500m Obst.(0,762)	80 (0,762) 220 (0,762)		
	Altura Longitud Triple Pértiga	Altura Longitud Triple Pértiga	Altura Longitud Triple Pértiga	Altura Longitud Triple Pértiga	Altura Longitud Triple Pértiga	Altura Longitud Pértiga Triple*	Altura Longitud Pértiga	Altura Longitud
Lanzam.	Peso (4 kg.) Disco (1 kg.) Jabalina (600 gr.) Martillo (4 kg)	Peso (4 kg.) Disco (1 kg.) Jabalina (600 gr.) Martillo (4 kg)	Peso (4 kg.) Disco (1 kg.) Jabalina (600 gr.) Martillo (4 kg.)	Peso (3 kg.) (****) Disco (1 kg.) Jabalina (500) (****) Martillo (3 kg.) (****)	Peso (3 kg.) Disco (800g) Jabalina (500) Martillo (3 kg.)	Peso (3 kg.) Disco (800) Jabalina (400) Martillo (3 kg.)	Peso (2 kg.) Disco (600g) Pelota (300g) Martillo (2 kg.)	Peso (2 kg.) Disco (600g) Pelota (200g) Martillo (2 kg.)
	4 x 100 4 x 400	4 x 100 4 x 400	4 x 100 4 x 400	4 x 100 4 x 400	4 x 100 4 x 300	4 x 80	4 x 60	4 x 50
Pruebas combinadas	Heptathlon 100 v. Altura Peso 200	Heptathlon 100 v. Altura Peso 200	Heptathlon 100 v. Altura Peso 200	Heptathlon 100 v. Altura Peso 200	Exathlon 100 v. Altura Peso	Pentathlon 80 v. Altura Peso Longitud Jabalina	Triathlon 60 Longitud Peso	Triathlon 50 Longitud Peso
	Longitud Jabalina 800	Longitud Jabalina 800	Longitud Jabalina 800	Longitud Jabalina 800	Longitud Jabalina 600			
Marcha	10 km. 20 km.	10 km. 20 km.	5 km. 10 km. 20 km.	5 km. 10 km.	3 km 5 km	3 km. 5 km.	2 km. 3 km.	1 km. 2 km.

* Carrera máxima 15m.
** Autorizadas con la valla de 0,84
*** Autorización a lanzar con artefacto junior (durante la temporada 2011/2012)

Figure 5.- Women's events Outdoor. Season 2011-2012.

**Events for which World Records are Recognised**

Fully Automatically Timed performances (F.A.T.)

Hand Timed performances (H.T.)

Transponder Timed performances (T.T.)

Men

Running, Combined and Race Walking Events:

- F.A.T. only: 100m; 200m; 400m; 800m;
110m Hurdles; 400m Hurdles;
4x100m Relay; 4x200m Relay; 4x400m Relay;
Decathlon.
- F.A.T. or H.T.: 1000m; 1500m; 1 Mile; 2000m; 3000m;
5000m; 10,000m; 20,000m; 1 Hour; 25,000m;
30,000m; 3000m Steeplechase;
4x800m Relay; 4x1500m Relay;
Race Walking (Track): 20,000m; 30,000m, 50,000m.
- F.A.T. or H.T.
or T.T.: Road Races: 10km; 15km; 20km; Half Marathon;
25km; 30km; Marathon; 100km; Road Relay
(Marathon distance only);
Race Walking (Road): 20km; 50km.
- Jumping Events: High Jump; Pole Vault; Long Jump; Triple Jump.
- Throwing Events: Shot Put; Discus Throw; Hammer Throw; Javelin
Throw.

Women

Running, Combined and Race Walking Events:

- F.A.T. only: 100m; 200m; 400m; 800m;
100m Hurdles; 400m Hurdles;
4x100m Relay; 4x200m Relay; 4x400m Relay;
Heptathlon; Decathlon.
- F.A.T. or H.T.: 1000m; 1500m; 1 Mile; 2000m; 3000m;
5000m; 10,000m; 20,000m; 1 Hour; 25,000m;
30,000m; 3000m Steeplechase;
4x800m Relay;
Race Walking (Track): 10,000m; 20,000m.
- F.A.T. or H.T.
or T.T.: Road Races: 10km; 15km; 20km; Half Marathon;
25km; 30km; Marathon; 100km; Road Relay
(Marathon distance only);
Race Walking (Road): 20km.
- Note: World Records in Road Races for women to be recognised in women
only races. The IAAF shall keep a separate list of "World Best
Performances" achieved in mixed Road Races.*
- Jumping Events: High Jump; Pole Vault; Long Jump; Triple Jump.
- Throwing Events: Shot Put; Discus Throw; Hammer Throw; Javelin
Throw.

Figure 6.- Outdoor events for which World Records are recognised by the IAAF.

Events for which World Indoor Records are Recognised

Fully Automatically Timed performances (F.A.T.)
Hand Timed performances (H.T.)

Men

Running, Combined and Race Walking Events:

F.A.T. only: 50m; 60m; 200m; 400m; 800m;
50m Hurdles; 60m Hurdles;
4x200m Relay; 4x400m Relay;
Heptathlon.

F.A.T. or H.T.: 1000m; 1500m; 1 Mile; 3000m; 5000m;
4x800m Relay;
Race Walking: 5000m.

Jumping Events: High Jump; Pole Vault; Long Jump; Triple Jump.

Throwing Event: Shot Put.

Women

Running, Combined and Race Walking Events:

F.A.T. only: 50m; 60m; 200m; 400m; 800m;
50m Hurdles; 60m Hurdles;
4x200m Relay; 4x400m Relay;
Pentathlon.

F.A.T. or H.T.: 1000m; 1500m; 1 Mile; 3000m; 5000m;
4x800m Relay;
Race Walking: 3000m.

Jumping Events: High Jump; Pole Vault; Long Jump; Triple Jump.

Throwing Event: Shot Put.

Figure 7.- Indoor events for which World Records are recognized by the IAAF.

There has been a recent amendment to the rule of the World Records in road races for women which caused some controversy. Those records have to be made in “women only” races from 2012 onwards, keeping the IAAF a separate list of “World Best Performances” achieved in mixed road races.

Spanish Records of the different age groups, as well as the “All time” best marks, are published periodically by the R.F.E.A (www.rfea.es), in the statistics zone of its webpage.

2.1.- TRACK EVENTS.

The official track programme is composed of 12 flat races, 3 hurdle races and two relay races. Races can be classified following the classification by Ballesteros (see table 1).

EVENT	Requirements	Duration	Requirements		
			Speed	Anaerobic Endurance	Aerobic Endurance
100 m	Speed	Short	↑↑↑	↑	
200 m		Long	↑↑↑	↑↑	
400 m	Speed endurance	Short	↑↑	↑↑↑	↑
800 m		Long		↑↑↑	↑↑
1500 m	Middle distance endurance	Short		↑↑	↑↑
3000 m		Medium		↑	↑↑↑
5000 m		Long		↑	↑↑↑
10000 m	Long distance endurance	---		↑	↑↑↑
1/2 Marathon	Great endurance	Short			↑↑↑
Marathon		Long			↑↑↑

Table 1.- Races classification (Adapted from Ballesteros).

2.2.- FIELD EVENTS.

There are 4 throwing events (Shot put, Discus, Javelin and Hammer throw) and 4 jumping events (High jump, Long jump, Triple jump and Pole vault). They are generally characterized by the following features:

- Neuromuscular predominance in its execution (coordination, reaction speed, power).
- Short competition executions.
- Athletes do not perform at the same time.
- Training is based more on the neuromuscular aspect than in the organic.
- They require the automation of the technical gesture.
- They need proper facilities and devices to be trained.

2.2.1.- JUMPING EVENTS.

They are composed of a running phase and a jump, with a take-off, flying phase and landing. In two of them the landing phase is done in a sand pit (Long jump and Triple jump), while the other two (Pole vault and High jump) use a mattress to land. Only pole vaulting needs an object to be performed, making its flying phase longer and more complex.

- a) **RUNNING PHASE:** It starts gradually, acquiring the maximum speed at the time of the take off. Depending on the event the center of gravity (CG) descends to a different extent in the last two supports (more in the high jump, less in the long jump, just a little in the triple jump, and almost nothing in the pole vault).
- b) **TAKE OFF:** The horizontal speed must be transformed in vertical and horizontal component depending on the type of the jump. The strength and direction of the movement, and the action of the arms and free leg are decisive in this phase.
- c) **FLYING PHASE AND LANDING:** When the take off is finished the trajectory of the CG cannot be modified, except in the Pole Vault, where it can be modified in the flying phase since the pole is still in contact with the ground. In the rest of jumps only in the landing phase the movement of the limbs can modify the body position.

The technical characteristics of the jumps are:

a) **WITH RESPECT TO THE TAKE OFF.** Figure 8 shows that the hip (as a representation of CG) is more advanced with respect to the take off place for long and triple jump, than for the high jump. Although the take off of the pole vault can be considered similar to the one of the long jump, the result of the CG path is different since the pole vault movement is articulated on the tip of the pole.

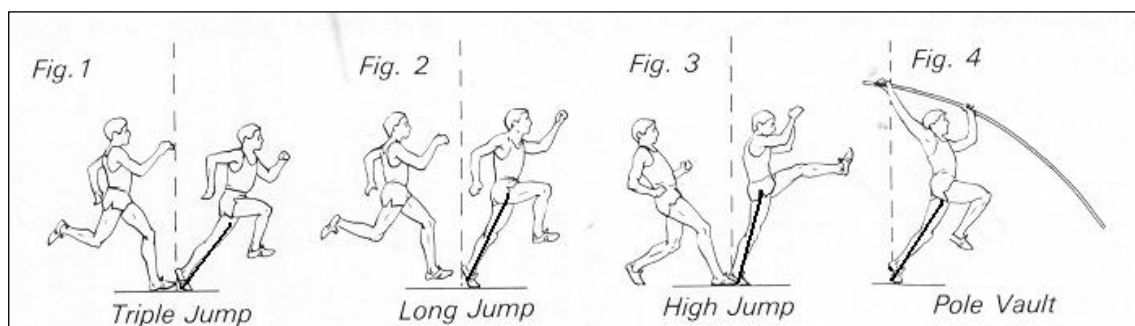


Figure 8.- Take off angles (with respect to the leg's position). Adapted from Ballesteros.

- b) WITH RESPECT TO THE TRAJECTORY OF THE CG. While in the long and triple jump the CG has a quite horizontal trajectory, in the high jump and the pole vault the vertical component is bigger than the horizontal one.

The most important variables of the jumps are:

- Take-off speed.
- Take-off angle.
- The **CG trajectory**, which depends on the previous two, and cannot be modified once the take off is done, except in the pole vault.

The factors that influence the jump are:

- The **speed of the running phase**: It provides the higher quantity of horizontal speed for the flying phase.
- **The drive of the take off**: It provides the right amount of vertical speed for the flying phase.
- The **flying parable**: Even though you cannot modify the trajectory of the CG, the athlete can still modify the position of the limbs in the flying phase to land more effectively.

2.2.2.- THROWING EVENTS.

Jesús Durán (2002), as we will see later in Topic 6, made a classification of the throwing events based on the weight of the implement (light or heavy) and depending on the throwing form (Rotation or Translation):

	Implement	Form	Initial position
SHOT-PUT	Heavy	Translation (also Rotation)	Backwards
DISCUS	Light	Rotation	Backwards
JAVELIN	Light	Traslation	Forward
HAMMER	Heavy	Rotation	Backwards

Table 2.- Classification of the throwing events (Duran, 2002).

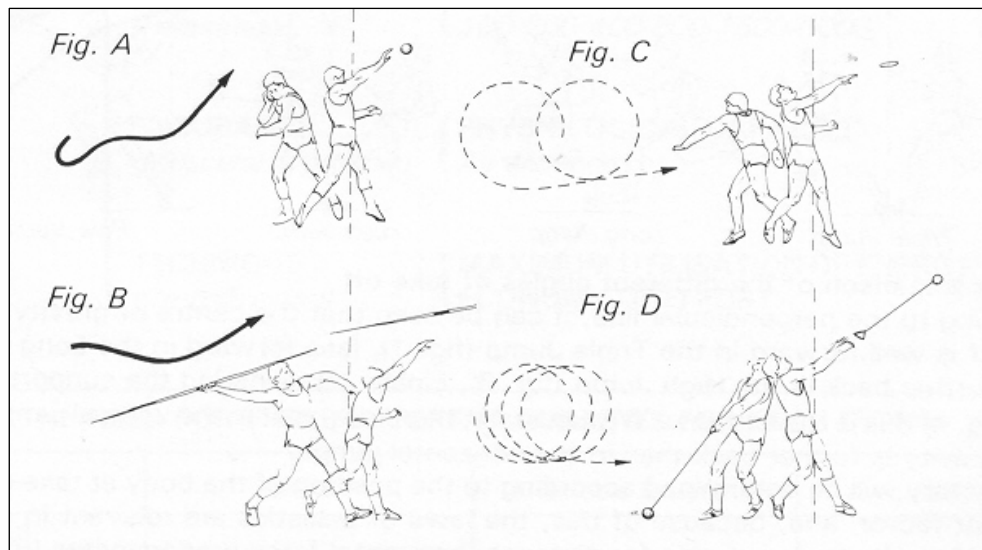


Figure 9.- Trajectories of the devices before the release (Ballesteros, 1992). Note: Shot Put can be performed with a Rotation also.

In the entire throw's starting position the device's velocity is "0". Along the throw we should increase it to get the higher possible release velocity.

The most important parameters of the throws are:

- The **velocity** of the device, it should be as high as possible, especially when we release it.
- The **impulse path**, which should be as large as possible and always finish with the support of the feet.
- The **angle of projection**, which must be optimal for the release velocity and for the device.

The average figures of the variables in the throwing events, as we will see on Topic 6, really depend on the biomechanical study, on the conditions under which the throws were done (training of competition, weather conditions, etcetera) and on the level of the throwers that were sampled. However, we will consider, as reference the following:

THROW	V_0 (*)	α_0
SHOT PUT	13-14	38 - 42°
DISCUS	24-26	33 - 39°
JAVELIN	≈ 28	27 - 36°
HAMMER	28-31	38 - 44°

Table 3. Reference parameters for the throwing events. (*) m/sec (Durán, 2002).

Factors influencing the throw are:

- The **preparatory phase** (preparatory movements).
- The **acceleration phase** (force application). Legs are usually the first part of the body to act in the beginning of the throwing action. Subsequently the trunk, shoulder, elbow and finally the hand, coordinating all segments to make a kinetic chain. However, according to Duran (2002), only in the hammer throw the legs action is delayed and is performed simultaneously with the trunk action.
- The **flying phase**. Light devices are affected by the device's aerodynamics and the wind; however these factors do not affect much to the heavy devices.

3.- WARM UP

Before starting a vigorous physical activity as a training session or competition, we must prepare the body for the effort performed. Alvarez del Villar (1987) consider the warm-up as "the set of activities or exercises, general first and then specific, taking place before any physical activity requiring an effort that exceeds the normal, to activate all the organs and prepare the athlete for maximum performance. Must be "somewhat methodical, severe and calculated, in which the athlete has to concentrate as much as for the competition", helping the athlete, if done correctly and concentrated, to overcome the psychosis of the competition. However, as bad as not warming up, it is to do it too intensely, because you can start the exercise with a significant oxygen debt, a previous neural fatigue and high lactic acid concentration, which would decrease the athlete's performance at the beginning of the effort.

Warm-up is for Ballesteros (1992), a "general preparation, mild and progressive, which must include agonist and antagonist muscles, joints, ligaments and organs (...) seeking a physiological and psychological tuning", and he makes an analogy of the human body with the engine of a car: "A car engine is not effective until its temperature rises and it is lubricated, also the 'human engine' do not perform well until it is warmed, physiologically speaking (...) Previously to compete, the engines have to be warmed before starting to run."

Both Ballesteros and Alvarez del Villar speak of the relativity of training, saying that for a trained athlete is a warm-up, it could be a workout for an untrained person.

3.1.- CHARACTERISTICS OF WARM-UP (WARM-UP).

For Ballesteros, warm-up involves an adaptation of the organism at different levels:

- a) Organic, preparing all the organs to perform at maximum level.
- b) Neuromuscular, allowing the best use of the power generated by the muscles.
- c) Biochemist, acting in the systems involved in the transport of energy substrates and their optimization.
- d) Psychological, mentally preparing the subject for the work to be done and avoiding "twitches".

For Alvarez del Villar (1987), warming has two key objectives: to help prevent injuries and prepare the athlete physically, physiologically and psychologically for the start of an activity more intense than normal, as is a training or competition. For him, the warm-up:

- Increases elasticity and decreases the likelihood of contractures or muscle tears.
- Prepares the cardio respiratory system and the neuromuscular system for the subsequent effort. When the cardiac activity is activated, it is increased irrigation and peripheral flow, so the blood gets better and more quickly throughout the body, bringing more nutrients and facilitating evacuation of waste products and providing transpiration as a form of thermoregulation.
- Increases muscle temperature, thereby decreasing the viscosity of the muscle fiber. This promotes muscle contractility by improving speed of contraction, the force of contraction and relaxation capacity.
- Reduces the anxiety by keeping the athlete concentrated in a methodical and efficient work.
- By practicing exercises similar to those that will be performed later, it allows the level of neuromuscular coordination required to produce the requested action.
- Reduces the risk of injury, especially in the antagonist muscles, which are most affected by injuries due to muscular incoordination.

3.2.- PERFORMING THE WARM-UP.

The warm-up has to be performed gradually from low to high intensity. Within any warm-up there is a **general warm up** part, which is usually performed without any auxiliary means, alternating runs and toning exercises with stretching and relaxation exercises and pauses. The final part is called **specific warm up** part, which prepares the individual for the task to be performed, and accustoms him to the environment and the instruments that he will be managing (the take off board, the landing area, the pole, the artefact to be thrown, the mat, etc.). In it, you need to make efforts which exercise the muscles involved in the activity to perform, more intense and with mechanical gestures similar to the discipline of competition.

The Argentinean Pendenza defines three phases on the warm-up:

- **Static Phase:** There are no sudden movements. Within this phase elongations of different muscle groups and joint mobilizations should be performed, and it may last 10 to 15 minutes.
- **Dynamic Phase without the element:** It is an active phase of 7 to 10 minutes that aims to increase oxygen consumption and the activity of the organism.
- **Dynamic Phase with the element:** Techniques to be used must be practiced with the elements necessary to compete.

For Ballesteros, the duration of the ideal warm-up was 25 to 50 min, including in this order:

- Easy running and very gentle exercises.
- Medium Intensity Exercises (generic ones).
- Stronger and more explosive exercises, some of them with similar intensity to the competition, but of shorter duration.
- Muscle relaxation and fluency exercises

For the Cuban Parris and her collaborators, the duration of the warm-up will depend on:

- Intensity and the duration of the activity to perform later.
- Age of participants.
- Emotional state.
- Type of sport.
- Level of fitness.
- Weather and time of the day.

The minimum duration for Parris would be 10 minutes: it could reach up to 30 minutes, especially for high performance athletes. High level athletes require a longer and more intense warm-up to the same level of relative effort compared with untrained athletes.

Extra or special clothes, massages and creams can complement a warm-up and help to do it more appropriately, but **they can never replace it**.

As important as a good warm-up it is to make an appropriate return to the calm (cool-down). Many injuries occur when the subject is coming back home or while sleeping, because there has been no process of relaxation and stretching after an extenuating effort.

3.3.- SOME PRACTICAL CONCEPTS TO TAKE INTO ACCOUNT DURING WARM-UP.

- Should we start with running? **NO**. You should start mobilizing the joints. In that way, you realize if you have some problem and you can decide running or not.
- How long you should run? **At least 10 minutes**. We have no time. Throwers and INEF student's → One lap to the track.
- **Easy running** activates you heart and breathing, and it increases the muscular temperature.
- **Time to stretch!** General stretching but focusing on the joints and muscles more involved in the subsequent activity.
- **Keep the order**. Try to start, for example, with the feet and go up through the whole body, finishing in the hands.
- **Circumductions** in the joints, **soft medium stretching** in the muscles.
- **After general stretching, focus on the weaknesses**. You have to insist in the stretching of the discomfort zones.
- **Insistences vs. rebounds**. **Insistence** forcing without going back to the origin. **Rebound** going and back (sometimes dangerous!).

- **Discomfort versus pain.** When you stretch you feel a nuisance (**discomfort**) that disappears when you finish the exercise. If the nuisance continues when you finish the exercise it is **pain**. **You never must feel pain after stretching, just a kind of pleasant itching or tingle.**
- **PNF Stretching** (or proprioceptive muscular facilitation). **SEE NOTE BELOW.**
- **Focus on abdominal and low back exercises.**
- **PILATES WORK:** Energy release from the core.
- **Prepare your body for the intense and real work at the end of the warm-up.**

3.4.- PNF STRETCHING (IMPROVING THE FLEXIBILITY).

Even though stretching and flexibility is not one of the main parts of a training session, and sometimes it can be counterproductive and should not be performed, it is important to know about it, and separate sessions focused on improving the flexibility can be planned as a part of a training cycle.

While there are several variations of PNF stretching, they all have one thing in common: they facilitate muscular inhibition. It is believed that this is why PNF is superior to other forms of flexibility training

Both isometric and concentric muscle actions completed immediately before the passive stretch help to achieve **autogenic inhibition** - a reflex relaxation that occurs in the same muscle where the Golgi tendon organ is stimulated. Often the isometric contraction is referred to as '**hold**' and the concentric muscle contraction is referred to as '**contract**'.

A similar technique involves concentrically contracting the opposing muscle group to that being stretched in order to achieve reciprocal inhibition - a reflex muscular relaxation that occurs in the muscle that is opposite the muscle where the Golgi tendon organ is stimulated.

Using these techniques of 'contracting', 'holding' and passive stretching (often referred to as 'relax') results in three PNF stretching techniques. Each technique, although slightly different, involves starting with a passive stretch held for about 10 seconds.

<http://www.youtube.com/watch?v=gvOQK8qNi9E&feature=related>

For clarity and to compare each technique, think of a hamstring stretch in the supine (lying on the back, face facing up) position for each example. The athlete places one leg extended, flat on the floor and the other extended in the air as close to the right angle with the body as possible.

3.4.1.- HOLD-RELAX TECHNIQUE. (Note: It may be also Contract-Relax Technique)

A partner moves the athlete's extended leg to a point of mild discomfort. This passive stretch is held for **10 seconds**. On instruction, the athlete isometrically contracts the hamstrings by pushing their extended leg against their partner's hand. The partner should apply just enough force so that the leg remains static. This is the 'hold' phase and lasts for **6 seconds**.

The athlete is then instructed to 'relax' and the partner completes a second passive stretch held for **30 seconds**. The athlete's extended leg should move farther than before (greater hip flexion) due to autogenic inhibition activated in the hamstrings.

3.4.2.- HOLD-RELAX AND CONTRACT AGONIST MUSCLE TECHNIQUE

A partner moves the athlete's extended leg to a point of mild discomfort. This passive stretch is held for **10 seconds**. On instruction, the athlete isometrically contracts the hamstrings by pushing their extended leg against their partner's hand. The partner should apply just enough force so that the leg remains static. This is the 'hold' phase and lasts for **6 seconds**. This initiates autogenic inhibition.

The partner completes a second passive stretch held for **30 seconds**, however the athlete is told to flex the hip (i.e. pull the leg in the same direction as it is being pushed). This initiates reciprocal inhibition allowing the final stretch to be greater.

Here are some other general guidelines when completing PNF stretching:

1. Leave 48 hours between PNF stretching routines.
2. Perform only one exercise per muscle group in a session.
3. For each muscle group complete 2-5 sets of the chosen exercise.
4. Each set should consist of one stretch held for up to 30 seconds after the contracting phase.
5. PNF stretching is not recommended for anyone under the age of 18.
6. If PNF stretching is going to be performed as a separate exercise session, a thorough warm up consisting of 5-10 minutes of light aerobic exercise and some dynamic stretches must precede it.
7. Avoid PNF immediately before, or in the morning, of a competition.

**4.- BIBLIOGRAPHY.**

- Álvarez del Villar, C. (1987) La preparación física del fútbol basada en el atletismo . Editorial Gymnos: Madrid.
- Ballesteros (1992). Manual Didáctico del Atletismo . Edited by the IAAF.
- Bravo, J., Campos, J., Durán, J., Martínez, J.L. (2000). Atletismo III. Lanzamientos . Edited by the R.F.E.A.: Madrid.
- Bravo, J., García-Verdugo, M., Gil, F., Landa, L.M., Marín, J., Pascua, M. (1992). Atletismo I. Carreras y Marcha . Edited by the R.F.E.A.: Madrid. <i>(Note: There is a more actual edition of this book, of Sprints and Hurdles.)</i>
- Bravo, J., López, F., Ruf, H., Seirul-lo, F. (1992). Atletismo II. Saltos . Edited by the C.O.E. (Spanish Olympic Committee) and the R.F.E.A.: Madrid. <i>(Note: There is a more actual edition of this book.)</i>
- Bravo, J., Ruf, H., Vélez, M. (2003). Atletismo II. Saltos Verticales . Edited by the R.F.E.A., Madrid.
- Duran, J.P. (2002) Manual Básico de Atletismo. Tomo II: Lanzamientos . R.F.E.A: Madrid.
- Gil, F., Pascua, M., Sanchez, R. (2000) Manual Básico de Atletismo . R.F.E.A: Madrid.
- I.A.A.F. (2011). Competition rules 2012-2013 .
- Parris, E., Parris, J.A., Tores, J., Dueñas M.V. Calentamiento . http://www.monografias.com/trabajos18/calentamiento/calentamiento.shtml . (October, 2005)
- Pendenza, R.R. Entrada en calor . http://www.monografias.com/trabajos16/entrada-en-calor/entrada-en-calor.shtml (October, 2005)
- R.F.E.A. (2011). “Reglamentación temporada 2011/2012” . Edited by the RFEA, Madrid.