Athletics

When you hear the word 'Olympics', what sports come to mind first? Chances are, one of those sports would be athletics, especially the running events like the exciting sprints, the nail-biting hurdles or the gruelling marathon. For many people, it is athletics that define the Olympic Games.

Allsport

Athletics is the original ancient Olympics sport, dating back to hundreds of years BC. Just as you might enjoy racing a friend, throwing a ball or frisbee or jumping over a puddle, for thousands of years our early ancestors competed with each other at activities such as running, throwing and jumping, just for fun. In time, people organised these games into official, scheduled competitions.

What do minerals, the building blocks of rocks, have to do with athletics and the Olympics? Plenty! Much of the equipment athletes use and that which measures their performance is made from minerals.

The following information sheets and student activities will help you find out more.

Information sheets

Olympic Men's 100m Sprint Results (Showing results in this race from 1896-1996)

Deciding the Winners (About the electronic equipment used in the Olympic Games)

Field Athletics Equipment

Olympic Men's Pole-vaulting Results

Teacher Cheat Sheet

Student activities

It's About Time (Looks at the minerals in electronic timing)

Altius and Fortius! (Looks at the minerals in field athletics equipment)

Metals: The Best Shot - Extension Idea

There are two types of athletics in the Olympics – **'track' and 'field'**.

Track athletics is made up of four types of events: running, hurdling, walking and relays. They take place on a track which is exactly 400m long around the inside of a stadium, such as the London 2012 Olympic Stadium, one of the new **Olympic venues** which has been made from **steel**.

Colin Jackson Allsport

Emma George Allsport

Field athletics consists of four throwing events (shotput, discus, hammer throw and javelin) and four jumping events (high jump, long jump, triple jump and pole vault) which generally take place at the same time as the track events, on an area within the boundary of the stadium's track.

DID YOU KNOW?

Women first participated in the Olympics in 1928, in five athletics events: discus, high jump, 100m sprint, 800m race and 4x100 m relay.

The word athlete comes from the Greek word for 'prize seeker'.

The winners are the fastest, fittest or strongest athletes in the world! In 1895, the Olympic motto of *Citius, Altius, Fortius* was written and its translation from the Latin is 'Swifter, Higher, Stronger'.

Athletes have certainly achieved these three goals over and over, with Olympic records regularly being broken over the decades.

A major contribution to this has been the use of minerals (the building blocks of rocks) in the modern equipment used by field athletes. In fact, it could be said that improvements in the materials and design of sports equipment have played a major role in helping athletes achieve incredible feats!

With competition getting tighter, modern measuring technology has become necessary to separate first and second place. This technology also depends on the huge number of minerals in the electronic devices.

Student Activity - It's About Time

Introduction

From the early 1900s, stopwatches were used to time athletes. Although they were made with metal parts and were a great invention at the time, they would not be suitable for today's Olympic events like the Men's 100m sprint in which competitors power from the start to the finish in less than 10 seconds!

IDEA: You could hold your own running race, using stopwatches to time the runners. Allocate three (3) time-keepers to each runner and compare the three times. Were they different?

As athletes push the limits further, especially in fast events such as the 100m sprint, just a fraction of a second can mean the difference between the gold, silver and bronze medallists.

How is that fraction of a second measured? Modern electronic equipment now enables officials to accurately and confidently declare the winner and the time. This electronic equipment contains the element **silicon** and many metals including **gold**, **copper**, **platinum, silver** and others.

Judges timing the 100m mens' final
Tokyo Olympics 1964 IOC

Timing and judging today Swatch

In the following activity you will learn about modern electronic timing devices and their importance, using the Olympic Men's 100 metre sprint as an example.

WHAT YOU NEED

Information sheets: Olympic Men's 100m Sprint Results

Showing the results of this race from 1896 to 2008

Deciding the Winners (about the various electronic equipment used in the Olympics)

WHAT TO DO

Task 1

Look at the two information sheets Olympics Men's 100m Sprint Results and Deciding the Winners.

- By how much did Hasely Crawford beat Donald Quarrie in the 1976 Games in Montreal, Canada? (Close, wasn't it!) Could a stopwatch have detected that difference? Why not?

- Of the 16 Olympic Games held between 1896 and 1968, in how many Games were the gold and silver medallists, or indeed the silver and bronze medallist, recorded as having exactly the same times?

Cathy Freeman, 1996 Atlanta Olympics
Allsport

In the 1996 Atlanta Olympics, Cathy Freeman finished second behind Olympic-record breaker Marie-Jose Perec of France in the Women's 400m sprint. Their times were: Perec: 48.35 seconds and Freeman: 48.63 seconds.

- If they had been running in the 1912 Olympics, with a rounded-off time of 48.4 and 48.6 seconds, is it possible that Cathy could have been awarded the gold medal? Explain your reasoning. (Hint: There was up to a 0.2 second difference or "spread" across the 3 stopwatches used, with the middle time of the 3 watches used to award the medals).
- Cathy Freeman went on to win the 400 metres at the 2000 Sydney Olympics in 49.11 seconds and claim the gold medal!

To overcome this problem, in the 1972 Olympics the timekeepers began taking times to 1/100th of a second, instead of only 1/10th (that is, to two decimal places instead of just one).

In the seven Games held since 1972, at which Olympics would the gold, silver or the bronze medalist in the Men's 100 metres have recorded the same times as each other under the old 1/10th system? (Hint: you need to round off the times to one decimal place).

Task 2

Now look at the information sheet Deciding the Winners (about the various electronic equipment used in the Olympics).

Even with a 1/100th system, the winner can not always be separated from second place, as happened with Alan Welles and Silvio Leonard in the 1980 Games in Moscow.

- How do you think Welles was able to be declared the winner?
- What electronic features have been introduced to help increase the accuracy of start and finish times and thus avoid a similar situation?

An electronic memory board is made of the following minerals –

silicon*
gold
silver
copper
platinum

* Silicon can be alloyed with indium, iridium etc to make it a good semi-conductor (ie. conducts electricity one way better than the other).

For any two of the metals used in electronics:

- Where are they mined in Australia?
- Where is the nearest of these mines to where you live?
- What properties do they have that make them useful in electronics?
- Write your own interesting or amazing ‘Did You Know?’ about each of them.

For help with your research go to the Rock Files websites and the Australian Mines Atlas.

http://www.australianminesatlas.gov.au/education/rock_files/index.html

http://www.australianminesatlas.gov.au/?site=atlas&tool=search

Information Sheet - Olympic Men's 100m Sprint Results

Year	Gold	Country	Time (secs)	Silver	Country	Time (secs)	Bronze	Country	Time (secs)
1896	Thomas Burke	USA	12.0	Fritz Hoffman	GER	12.2	Alajos Szokolyi	HUN	12.6
1900	Francis Jarvis	USA	11.0	Walter Tewksbury	USA	11.1	Stanley Rowley	AUS	11.2
1904	Archie Hahn	USA	11.0	Nathan Cartmell	USA	11.2	William Hogenson	USA	11.2
1908	Reginald Walker	SAF	10.8	James Rector	USA	10.8	Robert Kerr	CAN	11.0
1912	Ralph Craig	USA	10.8	Alvah Meyer	USA	10.9	Donald Lippincott	USA	10.9
1920	Charles Paddock	USA	10.8	Morris Kirksey	USA	10.8	Harry Edward	GBR	10.9
1924	Harold Abrahams	GBR	10.6	Jackson Scholz	USA	10.7	Arthur Porritt	NZL	10.8
1928	Percy Williams	CAN	10.8	Jack London	GBR	10.9	Georg Lammers	GER	10.9
1932	Eddie Tolan	USA	10.3	Ralph Metcalfe	USA	10.3	Arthur Jonath	GER	10.4
1936	Jesse Owens	USA	10.3	Ralph Metcalfe	USA	10.4	Martinus Osendarp	NED	10.5
1948	Harrison Dillard	USA	10.3	H Norwood Ewell	USA	10.4	Lloyd Labeach	PAN	10.4
1952	Lindy Remigino	USA	10.4	Herbert McKenley	JAM	10.4	Emmanuel McDonald Bailey	GBR	10.4
1956	Bobby Morrow	USA	10.5	Walter Baker	USA	10.5	Hector Hogan	AUS	10.6
1960	Armin Hary	GER	10.2	David Sime	USA	10.2	Peter Radford	GBR	10.3
1964	Robert Hayes	USA	10.0	Enrique Figuerola	CUB	10.2	Harry Jerome	CAN	10.2
1968	James Hines	USA	9.9	Lennox Miller	JAM	10.0	Charles Greene	USA	10.0
1972	Valeri Borzov	URS	10.14	Robert Taylor	USA	10.24	Lennox Miller	JAM	10.33
1976	Hasely Crawford	TRI	10.06	Donald Quarrie	JAM	10.08	Valeri Borzov	URS	10.14
1980	Allan Wells	GBR	10.25	Silvio Leonard	CUB	10.25	Petr Petrov	BUL	10.39
1984	Carl Lewis	USA	9.99	Sam Graddy	USA	10.19	Ben Johnson	CAN	10.22
1988	Carl Lewis	USA	9.92	Linford Christie	GBR	9.97	Calvin Smith	USA	9.99
1992	Linford Christie	GBR	9.96	Frank Fredericks	NAM	10.02	Dennis Mitchell	USA	10.04
1996	Donovan Bailey	CAN	9.84	Frank Fredericks	NAM	9.89	Ato Boldon	TRI	9.90
2000	Maurice Greene	USA	9.87	Ato Boldon	TRI	9.99	Obadele Thompson	BAR	10.04
2004	Justin Gatlin	USA	9.85	Francis Obikwelu	POR	9.86	Maurice Greene	USA	9.87
2008	Usain Bolt	JAM	9.69	Richard Thompson	TRI	9.89	Walter Dix	USA	9.91

Information Sheet - Deciding the Winners

Stopwatches

Timing was first introduced in the 1912 Stockholm Games with the use of hand-operated mechanical stopwatches. As these depended on human judgement and reactions, to click on a start/stop button with the thumb or finger, their accuracy was limited to 1/5th of a second. This might not sound much, but over a 100m race, which takes about 10 seconds, this is equal to an error of 2 metres!

The automatic stopwatch was introduced at the 1932 Los Angeles Games and improved accuracy to 1/10th or 0.1 of a second (one decimal place). A wire was placed across the finish line and when knocked by the winning runner, it triggered the stopwatch to stop timing. Also introduced in these Olympics was the use of newsreel film of each race with an in- built chronograph (time-measurer) to help decide the winner if two athletes seemed to cross the line and thus trigger the wire at the same time.

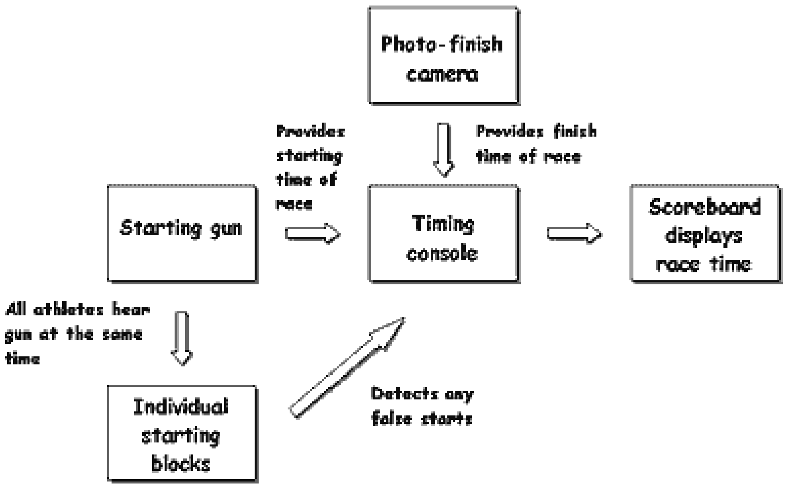
DID YOU KNOW?

In the 1932 Olympics 100m sprint between Americans Eddie Tolan and Ralph Metcalfe, both clocked in at 10.3 seconds. Luckily the judges used newsreel film and a chronograph image to determine the winner, but the trouble was, everyone had to wait until the film was developed to find out that Tolan had won the gold medal!

Electronic Equipment

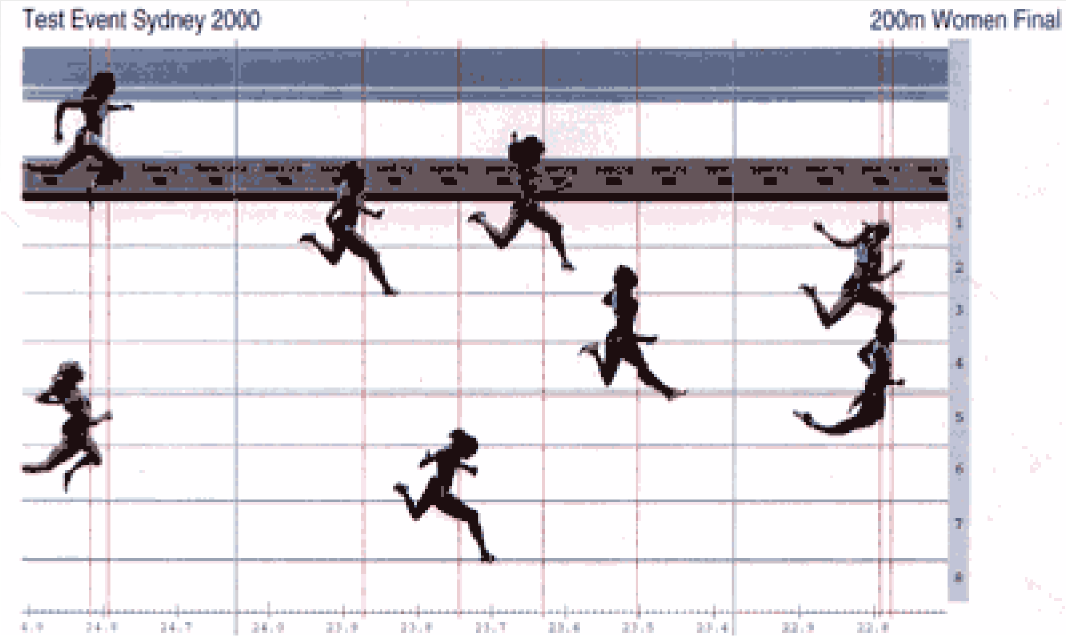
In electronic timing devices, an electrical current causes a quartz crystal to vibrate at an amazingly constant rate. This in turn controls a display of numbers. Electronic timing devices are extremely accurate and reliable. They were first used in the 1972 Olympics in Montreal and improved accuracy to 1/100th or 0.01 of a second (ie. two decimal places). Today they are actually capable of measuring to within 1/1000th of a second, 10 times the required accuracy under the rules!

Links between electronic timing and recording equipment



When the electronic starting gun fires, an electrical current passes through a **copper** wire cable to a timing console, triggering it immediately to start timing the race.

A photo-finish camera (first introduced in the 1948 Games but in its modern form only in the last decade) scans the finish line up to 2000 times per second and sends an electrical message to the timing console to signify when each runner's torso crosses the line.



The total running time for each athlete is then relayed to the judges and an electronic scoreboard.

Fair Go, Everyone!

The electronic starting gun and starting blocks act in two ways to make sure the race start is a fair one for all athletes:

1. If you were to fire an old-fashioned starting pistol, the sound it makes would travel through the air and the athletes closest to the pistol would hear the sound slightly before the others. Why wouldn't this be fair? The modern electronic starting gun allows all the athletes to hear the sound at exactly the same time. The gun is connected by **copper** wires to speakers at each of the starting blocks. This is especially important in races like the 400 metres sprint, where the athlete in the outside lane starts right around the curve from where the starting gun is fired!

2. To prevent any advantage to an athlete who accidentally starts to move before the gun is fired, the **aluminium** starting blocks also contain electronics that activate when the runner suddenly lurches forward, putting pressure on the pad. The difference between the moment the starting signal is given and the first movement is called the 'reaction time measurement'. Experts have conducted tests on human reactions times and worked out that even the quickest athlete couldn't possibly start moving off their block in less than 1/10th of a second from the moment they hear the gun. (Their nerves and muscles just aren't that fast!). So if the timer shows a reaction time measurement of, say, 0.09 seconds, then the athlete must have started to move before the gun was fired. The measurement device sends an audible signal to the starter's headphones, who then declares a 'false start'.

Electronic starting blocks Swatch

DID YOU KNOW?

In the 1900 Games in Paris, Francis Jarvis won the 100 m sprint and was recorded as "the winner by one foot from Walter Tewksbury, who beat Australian Stan Rowley by inches."   (Not very accurate, were they!)

In the first modern Games, in Athens in 1896, American Thomas Burke won the men's 100 m sprint using a "crouch" start, which fascinated the spectators. Until then, runners had started from a near-standing position. Later, starting blocks were introduced to replace holes dug in the ground. Originally made of wood, starting blocks are now made of an **aluminium** alloy with rubber-covered pressure pads.

Fifty years ago, we followed sports by reading the newspaper or listening to a radio. Results were often hours if not days old! Today we get instant coverage of major sporting events taking place around the world.

TV cameras are now sophisticated and small. They are positioned for close-ups of the action in the upright poles of the high-jump or in small golf-cart type vehicles which roll along the track ahead of the sprinters.

Some athletes have amazing reaction times. Cathy Freeman had a reaction time of just 0.223 seconds (less than a quarter of a second!) A possibility in the future is 'transponder technology', where individual athletes will have an electronic tag on them which will monitor and store data about their performance throughout an event such as a cross-country run.

Student Activity - Altius and Fortius!

Introduction

As well as getting faster on the track, athletes have also achieved greater length and height in jumping events (altius - higher) and longer distances in throwing competitions (fortius - stronger). For example, in the women's long jump in 1952, Yvette Williams from New Zealand won a gold medal with a jump of 6.23m at the 2008 games in Beijing Maurren Higa Maggi of Brazil won with a jump of 7.04m. However, the Olympic Record was achieved in the 1988 Games when Jackie Joyner-Kersee, from USA jumped 7.40m!

Why is this? Certainly athletes today are better prepared than ever, through:

- improved coaching and training methods
- diet know-how and excellent medical care
- improvements in technology - better machines for training, lycra clothing that reduces wind resistance and can cut times by up to 1/10th of a second, and better shoes that provide friction and grip (eg metal spikes or studs on shoes).

However, another vital contribution to athletes' performances is the many improvements in sports equipment that give the 21st century athlete a distinct advantage over his or her predecessors. Without minerals, many of these improvements would not be possible.

INVESTIGATION

In the following activity you will learn about some of the changes to field athletics equipment, including a look at the minerals of which they are made. You will consider the effects these changes might have had on field athletes' performances, and will look closely at exciting pole-vaulting as an example of athletes getting 'altius and altius'! The Extension Activity gives you a chance to consider why only certain metals are used in shot put.

WHAT YOU NEED

- Information sheets Field Athletics Equipment and Olympic Men's Pole-vaulting Results.
- Pencils, erasers and rulers
- Further information on Field Athletics can be found at the International Association of Athletics Federation website www.iaaf.org

Teachers can refer to the **Teacher Cheat Sheet** for helpful hints for question 1.

WHAT TO DO

1. Look at the information sheet Field Athletics Equipment:

   a. Highlight or circle any minerals mentioned (a metal is an example of a mineral).

   b. Which of the eight field events do not make use of minerals?

   c. Choose one jumping event and one throwing event and draw up a table like the one below. Fill in how you think the minerals might help in:

      - athlete performance,
      - safety or
      - fair competition.

Discuss and share your ideas as a class.

Example table:

Equipment	**Advantages**
Long jump	
Discuss	

2. Using data from the table **Olympic Men's Pole-vaulting Winners,** make a simple line graph showing year (26 spaces, horizontal axis) and height (27 spaces, vertical axis, labelled from 3.3m to 6.0m).

   a. In the 1920 and 1948 Olympics, why do you think the winning height was actually lower than for the previous Games? (Hint: think of world events).

   b. In the 1912 Olympics, a particularly greater increase in height was achieved. This is thought to be because people began to take a greater interest in sports around that time. More people started to participate and compete in sports and greater achievements were made as a result.

   c. Looking at the graph, name two other Olympic Games years when particularly greater increases in height were achieved and suggest why this might have happened. (Hint: Look again at the information in Field Athletics Equipment).

DID YOU KNOW?

Women's pole-vaulting was included for the first time in the Sydney 2000 Olympics.

OresomeResources - Queensland Resources Council - Minerals and Energy Education
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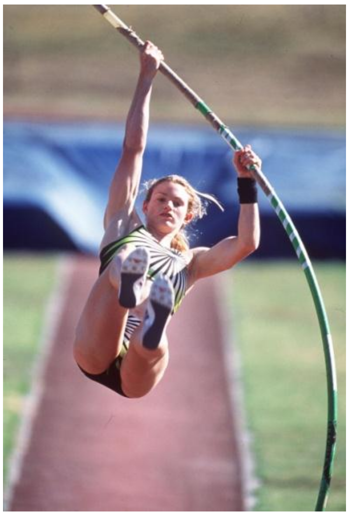
Level 13 133 Mary St Brisbane, Queensland 4000 – www.oresomeresources.com

Information Sheet - Field Athletics Equipment

	High Jump	
 NSIC	Aim and method: to sprint then leap over a crossbar which is placed at progressively greater heights. Jumps are measured from the ground to the underside of the crossbar.	Equipment: The rigid crossbar is generally made of lightweight metal such as aluminium. It weighs less than 2kg and rests on metal posts 4m apart. The posts are made from aluminium and zinc coated steel to remain resistant to corrosion. Jumpers now land on a plastic foam cushion, which has replaced the old sand pit!

	Pole Vault	
 Emma George Allsport	**Aim and method:** As with high jump, but athletes attempt to clear the crossbar with the aid of a flexible pole. Athletes sprint down a runway holding on to one end of the pole then digging the other end into a box or slot in the ground and swinging upward towards the crossbar. Doing a virtual handstand on the pole, they thrust their body facedown across the bar. Vaults are measured electronically from the ground to the upper side of the crossbar	**Equipment:** Prior to the 1940s, poles were made of wood and bamboo. With bamboo unavailable from Japan during World War II, metal was used. In the 1960s, an idea came from deep-sea fishing rods: lightweight fibreglass was used instead of metal. Fibreglass is a mixture of glass – made from the mineral **quartz** - and resin. Then in 1995, fibreglass with carbon was introduced. Poles are generally 4 – 5 metres long and weigh approximately 3.6 kg. Prior to World War II, the crossbar was made of steel. It is now constructed of fibreglass or **aluminium**.

	Long Jump	
 NSIC	Aim and Method: to sprint along a runway and leap forward as far as possible into a sand pit. Distance is measured from the front edge of the take-off board to the closest mark in the sand made by the jumper.	Equipment: At the ancient Games, jumpers held dumb-bell shaped lead or stone weights called halteres to increase their momentum and jump further. These are not allowed in the modern Olympics. In the past measuring tapes were used, but today Electronic Distance Measurements (EDMs) use an infra-red beam at the take-off board and a reflector at the athlete's landing point to more accurately measure the distance jumped. Judges look at plasticine imprints to check if the jumper has over-stepped the take-off.

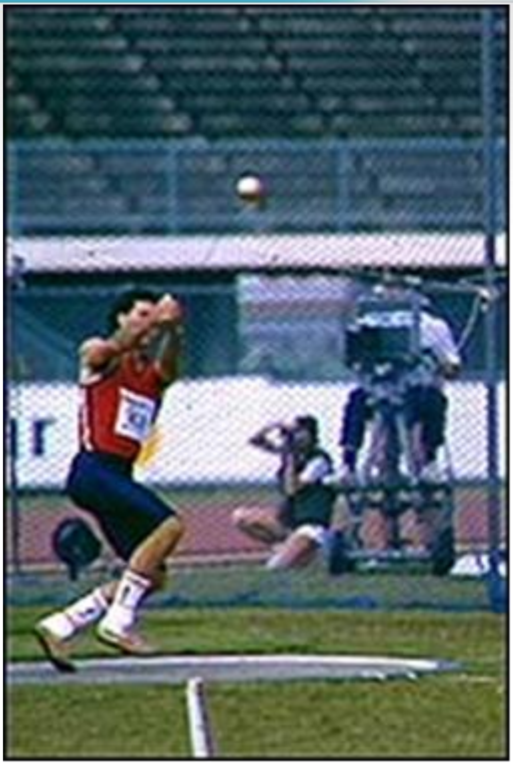
	Triple Jump	
 NSIC	**Aim and Method**: to sprint along a runway and using a hop, a step and a jump, propel oneself forward into a sand pit. The athlete first uses the hop (taking off and landing on the same foot) then the step (taking off and landing on different feet) then the jump, landing on both feet.	**Equipment:** Distances are measured as for the long jump.

	Shot Put	
 NSIC	Aim and Method: using one hand and gliding across the circle, the athlete propels the shot through the air for the maximum distance.	Equipment: Athletes originally threw a rock. This was replaced by an iron ball called a shot. Men put or push (do not throw) a 7.26 kg shot and women use a shot of 4.00 kg. The shot is made of solid iron, brass, stainless steel or any metal harder than brass. It can also be made of a shell of these metals filled with lead or other material. The shot must be sized within certain diameter limits. A lathe is used to machine finish it to be smooth and spherical. A men's shot might range from 110mm – 129mm and for the women 95mm – 109mm.

	Discus	
 NSIC	Aim and method: with upper body spinning, to project the discus as far as possible.	Equipment: The discus first appeared in the ancient Olympics in 708BC. Then the discus was made of stone, iron, bronze or lead and was shaped like a flying saucer. Sizes varied, as younger boys were not expected to throw the same weight as the men. Today, the discus may be solid or hollow and is generally made of wood, with a stainless steel circular rim. There can be circular plates set flush into the centre of the sides made of carbon-reinforced fibreglass. It is made to set specifications of shape, and weighs 2.0 kg for men and 1.0 kg for women.

	Hammer Throw	
 NSIC	Aim and method: to hurl a 'hammer' (a heavy ball attached via a length of wire to a metal handle) as far as possible. Athletes compete by gripping the handle with both hands and keeping their feet still, whirling the ball around in circles above their head. They then spin their body around three times to give even greater speed to the ball and release it upward and outward.	Equipment: The head (ball) can be made of solid iron, brass or any metal harder than brass. It can also be made from a shell of these metals and filled with lead or other material. It is smooth and round and with a minimum diameter of 110mm for men and 95mm for women. The steel wire attaching the head to the metal handle can be from 1.175 to 1.215 m in length. The wire must not be able to be stretched. It weighs at least 7.26 kg for men and 4 kg for women (the same as the shotput).

	Javelin	
 NSIC	**Aim and method:** Unlike other throwing events, the athlete is allowed to sprint 30m to a throwing line before hurling the javelin. The tip of the metal head must hit the ground first for the throw to be valid.	**Equipment:** Early javelins were spears made of wood, with a sharpened end or an attached metal point. They often broke. In the 1950s, a streamlined **aluminium** javelin was designed, enabling greater distances to be thrown. By the early 1980s, the aerodynamics had improved and the centre of gravity had to be modified to reduce distance! Javelins have three parts: a head, a shaft and a cord grip at the javelins' centre of gravity. (Place a ruler across your finger and where it balances is its centre of gravity. The shaft is smooth and often made of metal. The head is usually **steel** and tapers to a sharp point. The javelin must weigh at least 800 grams for men and 600g for women, and be 260 cm long for men and 220 cm for women. It must also be of specified width at certain points along its length.



NSIC

For all throwing events, instead of a time-consuming and inaccurate tape measure, an Electronic Distance Measurement (EDM) measures the distance from the throwing point to the impact point (of the javelin, for example) using an infra-red beam and reflector respectively.

It calculates the distance travelled using angle measurements, is accurate to within 1 mm, and the result is ready within about 10 secs.

In shot put, discus and hammer throw, the object must be thrown from within a circle with a diameter of 2.5m for discus and 2.135m for shot put and hammer throw. The ring of the circle is iron, steel or other suitable material and set flush with the ground with concrete or another material filling the centre.

In discus and hammer throw, this circle is partly surrounded by a cage for the safety of officials, competitors and spectators. The netting of this enclosure can be made of natural or synthetic fibre cord, or steel wire, provided it can stop a 2 kg discus moving at speeds up to 25 metres/sec, or a 7.26 kg hammer head moving at speeds up to 32 metres/s, and prevent ricocheting.

DID YOU KNOW?

After an incredible throw of 104.80 metres (just prior to the 1984 Los Angeles Games), a distance that threatened to endanger spectators and anyone on the surrounding 400m running track, a new style of javelin was introduced that year.

Its centre of gravity was moved back 10 cm – this different weight distribution stopped it from 'floating' and therefore shortened flight time and distance. It also made the javelin more prone to stick in the ground.

Distances thrown reduced to below 90m.

Information Sheet - Olympic Men's Pole-Vaulting Results

Year	Host city	Gold medallist	Country	Height(m)
1896	Athens	William Welles Hoyt	USA	3.30
1900	Paris	Irving Baxter	USA	3.30
1904	St Louis	Charles Dvorak	USA	3.50
1908	London	Edward Cooke Albert Gilbert	USA USA	3.71 3.71
1912	Stockholm	Harry Babcock	USA	3.95
1916	No Games (World War I)			
1920	Antwerp	Frank Foss	USA	4.09
1924	Paris	Lee Barnes	USA	3.95
1928	Amsterdam	Sabin Carr	USA	4.20
1932	Los Angeles	William Miller	USA	4.31
1936	Berlin	Earle Meadows	USA	4.35
1940	No Games (World War II)			
1944	No Games (World War II)			
1948	London	O Guinn Smith	USA	4.30
1952	Helsinki	Robert Richards	USA	4.55
1956	Melbourne	Robert Richards	USA	4.56
1960	Rome	Donald Bragg	USA	4.70
1964	Tokyo	Fred Hansen	USA	5.10
1968	Mexico City	Robert Seagren	USA	5.40
1972	Munich	Wolfgang Nordwig	GDR	5.50
1976	Montreal	Tadeusz Slusarski	POL	5.50
1980	Moscow	Wladyslaw Kozakiewicz	POL	5.78
1984	Los Angeles	Pierre Quinon	FRA	5.75
1988	Seoul	Sergei Bubka	URS	5.90
1992	Barcelona	Maxim Tarassov	EUN	5.80
1996	Atlanta	Jean Galfione	FRA	5.92
2000	Sydney	Nick Hysong	USA	5.90
2004	Athens	Tim Mack	USA	5.95
2008	Beijing	Steven Hooker	AUS	5.96

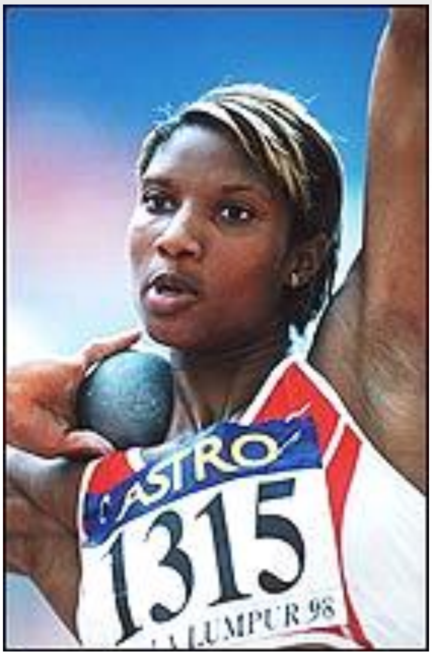
Be sure to watch the London Olympic Games Pole Vaulting event as Australian Steve Hooker defends his Olympic title! The final will be held on August 10th.

Teacher Cheat Sheet

Equipment	Advantages
High jump	Alloyed metal crossbar will not break or hurt the athlete if it falls. Crossbar will be equal height above ground along its length allowing fair competition and measurement. Softer landing allows greater heights to be surmounted safely.
Pole vault	Alloyed metal crossbar as above. Fibreglass in the pole itself gives even more bend and thus allows for a higher hand hold. This allows the athlete to gain greater heights.
Long jump	Take-off board electronics, containing many minerals, allow more accurate measurements. Less chance of fouling with foot over the line.
Triple jump	As above
Shot put	Iron or brass shots can be accurately made to specified shapes and weights, making competition fair, and maximising equipment quality for the athletes. The throwing circle surface is made from a firm but non-slippery material, and its ring is strong and durable metal (iron or steel)
Discus	As above for the construction of the discus, plus the steel rim will not be damaged each time the discus lands, and the fibreglass inserts add strength without too much weight. As above for the throwing circle. The fibre cord or steel wire cage is strong and minimises dangerous rebound of the object.
Hammer Throw	As above for the construction of the hammer, plus the steel wire attaching the handle is strong but not stretchable. As above for the throwing circle. As above for the cage.
Javelin	As above for the construction of the javelin. The introduction of aluminium made it easier to throw further. Steel tip penetrates ground easily.

ORESOME RESOURCES
Minerals and Energy Education

EXTENSION IDEA - Metals: The Best Shot



Allsport

An activity based on the shot put for those who like a challenge!

In shot put, the shot must be made of a substance that is heavy enough, yet not too big nor too small.

Density is a measurement of the mass (measured in kilograms or grams) compared to the volume (measured in cubic metres or cubic centimetres).

Density = mass/volume

An object's volume can be worked out by dividing its mass by its density.

Volume = mass/density

Densities of various metals

Metal	**Density (g/cm^3)**	**Mass of the 4 kg shot (g)**	**Volume of the 4 kg or 4000 g shot (cm^3)**
Aluminium	2.7	4000	
Zinc	7.1	4000	
Iron	7.8	4000	512
Copper	8.9	4000	
Lead	11.9	4000	
Gold	19.3	4000	

Using your calculator, fill in the table above by working out the volume of the womens' 4kg shot, if it was made from each of the metals listed in the table. The completed example shows that a 4000g shot of iron (density 7.8 g/cm3) is 4000/7.8 cm3 = 512 cm3, the correct size of a shot.

1. Which metals would make shots too big? Why would this be a problem for the athletes?
2. Shots can also be made of brass, an alloy (combination) of copper and zinc. Using the data in the above table, explain why brass would create a shot of similar size to one made of iron?
3. Using copper, lead and gold would make shots smaller than the specified sizes for competitions. However, apart from size, there are also other reasons these metals would be unsuitable.
    a. Why would copper be unsuitable? (Hint: think of a copper wire – what features does it have?)
    b. Gold has the same problem, and anyway it would be a silly idea as it would cost a fortune! Why do you think gold is so expensive?

Why wouldn't it be a good idea to use lead? (Hint: think about types of petrol. Why do we have unleaded petrol?)

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