# A Complete Guide to fitness, sports & nutrition

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2 CD Pack

Training makes a difference...

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# Sport

Women's Australian rules football is a team sport.

A **sport** is an activity requiring physical ability, physical fitness or physical skill which usually, but not always, involves competition between two or more people.

## History

There are artifacts and structures that suggest that the Chinese engaged in sporting activities as early as 4000 BC. Gymnastics appears to have been a popular sport in China's ancient past. Monuments to the Pharaohs indicate that a number of sports, including swimming and fishing, were well-developed and regulated several thousands of years ago in ancient Egypt.  Other Egyptian sports included javelin throwing, high jump, and wrestling. Ancient Persian sports such as the traditional Iranian martial art of Zourkhaneh had a close connection to the warfare skills. Among other sports that originate in Persia are polo and jousting.

In Europe, ancient Irish legends show evidence of the ancestor of modern hurling being used as a means of preparing warriors for battle as far back as the 13th century BC.

A wide range of sports were already established by the time of Ancient Greece and the military culture and the development of sports in Greece influenced one another considerably. Sports became such a prominent part of their culture that the Greeks

created the Olympic Games, which in ancient times were held every four years in a small village in the Peloponnesus called Olympia.

Sports have been increasingly organized and regulated from the time of the Ancient Olympics up to the present century. Industrialization has brought increased leisure time to the citizens of developed and developing countries, leading to more time for citizens to attend and follow spectator sports, greater participation in athletic activities, and increased accessibility. These trends continued with the advent of mass media and global communication. Professionalism became prevalent, further adding to the increase in sport's popularity, as sports fans began following the exploits of professional athletes through radio, television, and the internet--all while enjoying the exercise and competition associated with amateur participation in sports.

# Sportsmanship

**Sportsmanship** is an attitude that strives for fair play, courtesy toward teammates and opponents, ethical behavior and integrity, and grace in losing.

Sportsmanship expresses an aspiration or ethos that the activity will be enjoyed for its own sake. The well-known sentiment by sports journalist Grantland Rice, that it's “not that you won or lost but how you played the game," and the Modern Olympic creed expressed by its founder Pierre de Coubertin: "The most important thing . . . is not winning but taking part" are typical expressions of this sentiment.

But often the pressures of competition or an obsession with individual achievement—as well as the intrusion of technology—can all work against enjoyment and fair play by participants.

People responsible for leisure activities often seek recognition and respectability as sports by joining sports federations such as the IOC, or by forming their own regulatory body. In this way sports evolve from leisure activity to more formal sports: relatively recent newcomers are BMX cycling, snowboarding, and wrestling. Some of these activities have been popular but uncodified pursuits in various forms for different lengths of time. Indeed, the formal regulation of sport is a relatively modern and increasing development.

Sportsmanship, within any given game, is how each competitor acts before, during, and after the competition. Not only is it important to have good sportsmanship if one wins,

but also if one loses. For example, in football it is considered sportsmanlike to kick the ball out of play to allow treatment for an injured player on the other side. Reciprocally, the other team is expected to return the ball from the throw-in.

Violence in sports involves crossing the line between fair competition and intentional aggressive violence. Athletes, coaches, fans, and parents sometimes unleash violent behaviour on people or property, in misguided shows of loyalty, dominance, anger, or celebration.

# Professionalism and regulation

*Professional sport*

The entertainment aspect of sports, together with the spread of mass media and increased leisure time, has led to professionalism in sports. This has resulted in some conflict, where the paycheck can be seen as more important than recreational aspects: or where the sports are changed simply to make it more profitable and popular therefore losing some of the traditions valued by some.

The entertainment aspect also means that sportsmen and women are often elevated to celebrity status.

# Politics

At times, sports and poltics can have a large amount of influence on each other.

When apartheid was the official policy in South Africa, many sports people adopted the conscientious approach that they should not appear in competitive sports there. Some feel this was an effective contribution to the eventual demolition of the policy of apartheid, others feel that it may have prolonged and reinforced its worst effects.

The 1936 Summer Olympics held in Berlin was an illustration, perhaps best recognised in retrospect, where an ideology was developing which used the event to strengthen its spread through propaganda.

In the history of Ireland, Gaelic sports were connected with cultural nationalism. Until the mid 20th century a person could have been banned from playing Gaelic football, hurling, or other sports administered by the Gaelic Athletic Association (GAA) if she/he

played or supported soccer, or other games seen to be of British origin. Until recently the GAA continued to ban the playing of soccer and rugby union at Gaelic venues. This ban is still enforced, but has been modified to allow football and rugby be played in Croke Park while Lansdowne Road is being redeveloped. Until recently, under Rule 21, the GAA also banned members of the British security forces and members of the RUC from playing Gaelic games, but the advent of the Good Friday Agreement in 1998 led to the eventual removal of the ban.

Nationalism in general is often evident in the pursuit of sports, or in its reporting: people compete in national teams, or commentators and audiences can adopt a partisan view. These trends are seen by some as contrary to the fundamental ethos of sports being carried on for its own sake, for the enjoyment of its participants.

# Art

Sports have many affinities with art. Ice skating and Tai chi, for example, are sports that come close to artistic spectacles in themselves: to watch these activities comes close to the experience of spectating at a ballet. Similarly, there are other activities that have elements of sport and art in their execution, such as performance art, artistic gymnastics, Bodybuilding, Parkour, Yoga, Bossaball, dressage, etc. Perhaps the best example is Bull-fighting, which in Spain is reported in the arts pages of newspapers.

The fact that art is so close to sports in some situations is probably related to the nature of sports. The definition of "sports" above put forward the idea of an activity pursued not just for the usual purposes, for example, running not simply to get places, but running for its own sake, running as well as we can.

This is similar to a common view of aesthetic value, which is seen as something over and above the strictly functional value coming from an object's normal use. So an aesthetically pleasing car is one which doesn't just get from A to B, but which impresses us with its grace, poise, and charisma.

In the same way, a sporting performance such as jumping doesn't just impress us as being an effective way to avoid obstacles or to get across streams. It impresses us because of the ability, skill, and style which is shown.

Art and sports were probably more clearly linked at the time of Ancient Greece, when gymnastics and calisthenics invoked admiration and aesthetic appreciation for the physical build, prowess and 'arete' displayed by participants. The modern term 'art' as skill, is related to this ancient Greek term 'arete'. The closeness of art and sport in these times was revealed by the nature of the Olympic Games which, as we have seen, were celebrations of both sporting and artistic achievements, poetry, sculpture and architecture.

# Technology

Technology has an important role in sports, whether applied to an athlete's health, the athlete's technique, or equipment's characteristics.

**Equipment** As sports have grown more competitive, the need for better equipment has arose. Golf clubs, baseball bats, soccer balls, hockey skates, and other equipment have all seen considerable changes when new technologies have been applied.

**Health** Ranging from nutrition to the treatment of injuries, as the knowledge of the human body has deepened over time, an athlete's potential has been increased. Athlete's are now able to play to an older age, recover more quickly from injuries, and train more effectively than previous generations of athletes.

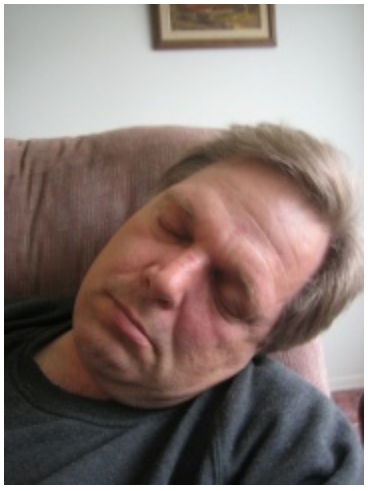
**Instruction** Advancing technology created new opportunities for research into sports. It is now possible to analyse aspects of sports that were previously out of the reach of comprehension. Being able to use motion capture to capture an athlete's movement, or advanced computer simulations to model physical scenarios has greatly increased an athlete's ability to understand what they are doing and how they can improve themselves.

# Terminology

In Commonwealth English, sporting activities are commonly denoted by the collective noun "sport". In American English, "sports" is more common for this usage. In all English dialects, "sports" is the term used for more than one specific sport. For example, "football and swimming are my favourite sports", would sound natural to all English speakers, whereas "I enjoy sport" would sound less natural than "I enjoy sports" to many North Americans.

# Alternative Health

## How to Adopt a Polyphasic Sleep Schedule



napping

Polyphasic sleep, also known as the Uberman Sleep Schedule, is a sleep pattern that reduces sleep time to 2-5 hours daily, supposedly allowing people to sleep less but feel alert. If you want up to 6 hours extra time in a day without feeling sleep deprived or fatigued and can try adjusting the rest of your life to follow this strict and unusual schedule.

## Steps

1. The 'mini' schedule: You will only have to sleep for around 4 hours and 40 minutes per day.
2. Around 3 AM, sleep for 4 hours until 7 AM. This is your core sleep.
3. If you feel tired at 9 AM, take a 20 minute nap, if not, leave it.
4. Take a nap at 1 PM for 20 minutes.
5. Take a nap at 6 PM for 20 minutes.
6. Repeat every day.
7. The Full Blown polyphasic sleep schedule, which gives you about 6 hours extra time in a day:
8. Take a nap at 8 AM
9. Take a nap at 4 PM
10. Take a nap at midnight
11. Take a nap at 4 AM
12. Repeat every day.

## Tips

- With polyphasic sleep, the first few days to weeks your brain will struggle to fit in, but when it does, you will theoretically get the necessary aspects of sleep in the naps, leaving you feeling refreshed.
- Only take step number 2 of the mini schedule if you feel tired.

## Warnings

- There is little scientific research into polyphasic sleep and most information about it comes from independent researchers without peer review.
- DO NOT OVERSLEEP, as it will fatigue you for at least the duration of 2 naps.
- Do not skip naps, as it will also tire you.
- Do not ingest caffiene.
- DO NOT attempt this method if you have any type of a diagnosed epileptic disorder. Insufficient rest may cause discomfort/attacks.
- It is not fully known if there are physical or psychological risks involved with this procedure. However, there are books written on the subject which states it is not unhealthy if it is done for 6 months, which is as far as the experiments go. If you perform this procedure for more than 6 months, you are moving into uncharted waters.

# How to Avoid Perimenopause Woes

Perimenopause normally happens about six years before full menopause begins.

And No! You don't have to ingest (HRT)a pregnant mare's urine! Besides, it's been proven to be much too dangerous. This has prompted many women to search for other options.

Alternative health care therapies are available to perimenopausal women.

Nutrition and nutritional supplementation are biggies to avoid perimenopause woes. Start as early in your younger years as you can. Or if you're already into it, it's not too late.

Get serious and you will begin to feel and see some changes.

Besides choosing plant-based alternatives to hormone replacement therapy (HRT), also recommended:

## Steps

1. Reduce stress in your life
2. Healthy Diet
3. Exercise is one method of stress reduction that reduces hot flashes
4. Nutritional supplements support and work with a woman's body, not against it
5. Prayer
6. Meditation
7. Yoga
8. Tai chi can all be used to control your body's stress response and reduce menopausal symptoms.

## Tips

- Herbs, homeopathy, acupuncture, and other self-help measures support and work with a woman's body, not against it, thereby reducing the dread of perimenopause and helping to avoid perimenopause woes!

## Warnings

- To fight hot flashes related to perimenopause woes, keep a portable fan nearby, avoid spicy meals and alcohol, and eat foods high in hormone -balancing phytoestrogens like soy nuts or tofu. Get serious and you can avoid perimenopause woes.

# How to Breathe Deeply

Breathing deeply can develop a calm mind and strong spine

## Steps

1. Position-Supine, with knees bent and feet flat on floor or table
2. Bring attention to body & breath-Notice contact points with floor & breathing pattern (“where is there movement with the breath”)
3. Bring Breath into lower trunk-Let most of the movement of the breath be below the ribcage (“Belly, low back and pelvis”)
4. Bring attention to area inside of pelvis
5. Pelvis is shaped like bony bowl with hole in bottom

6. Within bony bowl is a muscular bowl going from front of pelvis (pubis) to tailbone like a hammock. When you have to go to the bathroom, you lift this hammock to “hold it”, and when you get to the toilet you release these pelvic floor muscles to evacuate bowel/bladder.
7. See if you can feel a subtle movement with the breath in these pelvic floor muscles
8. Accentuate the movement of the pelvic floor with the breath.
9. Inhale – Relax pelvic floor down.
10. Exhale – Very gently draw pelvic floor toward the head.
11. Quadrants of pelvic floor
12. Left & Right
13. Back & Forward
14. Slow motion marble rolling image
15. Release back of pelvic floor with inhale.
16. Draw anterior pelvic floor up with exhale.
17. Bring the attention to the abdomen.
18. Continue breathing with pelvic floor
19. What does the belly do on the exhale?
20. Draw navel in on exhale
21. Relax belly on inhalation
22. Bring attention to the throat.
23. Use glottis to slow down expiration
24. Ujai
25. Whispered “ah”
26. Darth Vader Breath
27. Continue with (8) and notice any change in pelvic floor and deep abdominal muscles. Feel connection between glottis and expiratory muscles. Play with different ways of coordinating the pelvic, thoracic and cervical diaphragm.
28. Inhaling with abdominal and pelvic muscles engaged
29. Instead of completely relaxing deep abdominal and pelvic floor muscles on inhalation, maintain sufficient contraction to stabilize lumbar spine and pelvis.
30. Do not allow upper chest to expand on inhale
31. Imagine compressing ball of energy near navel
32. Pelvic floor and deep abdominals “fight” diaphragm
33. on inhale diaphragm “wins”
34. on exhale pelvic floor and abdominals “win”

# Tips

- be gentle and patient

# Warnings

- if you get dizzy or lightheaded, you are breathing too quickly

# How to Breathe Like a Yoga Master

You don't have to vacation in the Himalayas to learn to breathe like a Buddha. From the Pranayama tradition of yoga comes the "Complete Breath," which is a relaxing way to beat stress and improve your state of mind.

## Steps

1. **Lie down on your back** on the floor, a comfortable mat, or a firm mattress.
2. **Place your hands** an inch or two apart just below the navel, with your fingertips facing inward and your palms down.
3. **Inhale through the nose** and begin expanding the abdomen.
4. **Continue inhaling.** When the abdomen rises slightly, begin allowing the chest to expand and the abdomen to fall.
5. **When the chest rises slightly, begin exhaling.** Allow the abdomen to continue to fall.
6. **Continue exhaling.** As the chest empties, allow the abdomen to begin to rise again.
7. **Repeat** without pausing.

## Tips

- It can be tricky to get the hang of this at first, but it helps to imagine the breathing cycle as a circle. During each cycle, the chest and abdomen rise and fall in a smooth, uninterrupted manner.
- Each inhalation/exhalation cycle should require several seconds to complete. Use a pace that is comfortable for you, but the deeper and slower you are able to breathe, the better.

## Warnings

- If you begin to feel light-headed or experience other unusual phenomena, do not continue the exercise.

# How to Buy Essential Oils

Essential oils are highly concentrated, volatile oils that can be extracted from aromatic plants. Their use dates back to ancient times, and their wide variety of therapeutic, medicinal and culinary uses has ensured their continued popularity. About 700 different kinds of plants contain useful essential oils, and you can find many of these online or in

your local health food store, farmers market or co-op. In fact, the variety can be a bit bewildering, and because many pounds of plant material are required to extract an ounce of essential oil, the prices can be overwhelming, too. This brief buyer's guide can help you get the best quality and value.

## Steps

1. Think about why you want an essential oil. Different essential oils have different uses, so your first step should always be to determine which one will best suit your needs. You can research essential oils online, or you can ask your herbalist, natural foods grocer or a knowledgeable friend. Depending on your needs, you may find that more than one kind of oil is suitable. If you don't have a clear reason for choosing one over the other, look at their prices--essential oils vary widely in price, so why pay more than you have to?
2. Consider alternatives to pure essential oil. Hydrosols? Absolutes? Fragrance oils? There are often cheaper alternatives to essential oils that may perform the service you need. A hydrosol, hydrolate or water essence (as in rose water, lavender water, etc.) is the byproduct of distillation. When plants are distilled, the vapor condenses into essential oils and hydrosols; these are then separated. A hydrosol is basically essential oil diluted in water, and it will usually contain some other incidental organic compounds. They can frequently be used in place of essential oils when dilution is not an issue, as in some aromatherapy methods. Absolutes are generally highly concentrated essential oils which are extracted with solvents, usually from flowers for which steam distillation is impractical. These can be more expensive than essential oils, but you may be able to dilute them more for the same uses. Fragrance oils, also sometimes called floral waters, are usually synthetic compounds which have an aroma similar to essential oils. They are cheaper than essential oils, but are typically not suitable for therapeutic or culinary uses. You can also purchase essential oils diluted in a carrier oil, such as almond or grapeseed oil. These may in some cases be a better choice, particularly if you plan to apply the oil to your skin. You will probably find a wide range of dilutions for sale.
3. Get an idea of the going price. Once you know what product you want, try to find the best price for it. Check locally and online, but make sure you're comparing comparable quantities of comparable dilutions of comparable products. Make a list of the best prices you find and where you find them. Chances are you will find the general price hovering in a certain range. If a given choice falls far below that range, look into it, but beware: something smells fishy.
4. Learn about the oil you want to purchase. Knowledge is power, and the more you can learn about the product, the better value you will be able to get. Essential oils vary in quality depending on which parts of the plants are included--lavender oil, for example can be made with lavender flowers and stalks or just with the flowers, the latter being of higher quality--the method of extraction (steam distilled is usually better than water distilled), country or region of origin, and time of harvest.

5. Find out as much as you can about your choices. Being an informed buyer, you can now ask the potential sellers the important questions. First, look at the bottles or, if shopping on the internet, carefully read the product descriptions. You should be able to get a clear idea of what you're getting. If possible, smell several oils to compare their aromas. Find out how the plants are harvested, where they're grown, etc. Next research the companies that manufacture the oils you're considering. You can look on the internet or ask friends or retailers. It's important to find out as much information as you can about the oil, but it's also important to find out if the information you're getting is coming from a reputable source.
6. Consider how the oils are stored. Essential oils should always be kept in a dark glass bottle or stainless steel container. Oils not contained in these are suspect. In addition, essential oils should be protected from excessive heat or direct sunlight. You have an advantage shopping locally because you can see how the oils are stored--are the bottles on a windowsill?--but reputable companies can usually be trusted to use proper storage techniques.
7. Make your purchase and start enjoying the benefits of essential oils.

## Tips

- Some oils are organically grown or certified organic; you may need to pay a premium for these. If buying organic is important to you, exercise this option. Otherwise, it is not entirely clear that there are benefits to organically produced oils--it can be argued that the extraction process, especially distillation, removes pesticide and herbicide impurities.
- If the cost of essential oils seems a bit much to you, you can make your own. Warnings

- Beware of oils that are sold in clear glass or plastic. Essential oils need to be protected from sunlight, which can quickly damage them. Essential oils degrade most plastics quickly.
- Beware of a line of essential oils that are are all sold for the same price. Because the cost of extracting different oils varies dramatically, it is simply impossible that the oils are pure and of good quality.

# How to Choose Fish Oil Supplements

Tips on choosing quality fish oil supplements.

## Steps

1. Choose supplements that are manufactured under strict GMP (Good Manufacturing Practice) compliance.
2. Choose the supplements that contain high potency of DHA.
3. The fish oil should be in ester form.

4. Choose the supplements that are processed with molecular distillation to ensure that the products are pure and free from contaminants.

## Tips

- Try putting the capsule in the freezer overnight. If the capsule freezes it's not good quality. A pure fish oil capsule will not freeze.
- High quality fish oil capsules have only a mild fishy smell. Poor capsules have an overpowering fish smell.
- Take fish oil before meals to avoid bad breath.

## Warnings

- Many low quality fish oil can cause heavy metal poisoning.

# How to Choose Vitamin Supplements

Here's a guide for choosing quality vitamin supplements.

## Steps

1. Make sure the supplements meet FDA's Good Manufacturing Practices (GMPs) for foods.
2. Look for products labeled "enteric coating", "food glaze", and “ethyl cellulose". This means the supplements have good bioavailability.
3. Ensure that the ingredients of the supplements are supported by a COA(Certificate of Analysis).
4. Always consult your health care provider about the supplements you are taking. Present them the labels.
5. Choose supplements that have no artificial coloring/flavoring.
6. Choose products with a long shelf life.

## Tips

- Identify your health goals and find out the best supplement to achieve them.

## Warnings

- The supplements might be contaminated
- The supplements might contain more of less of the ingredients stated on the labels.

# How to Choose and Cleanse Crystals for Healing

If you enjoy using alternative healing techniques to look and feel better, working with crystals may be ideal for you. Read on to learn how to find the right crystal for you, and how to cleanse them before use.

## Steps

1. Find a shop or website that sells crystals. If you are new to working with the subtle energies of crystals you'll probably find it easier to select your crystals in person.
2. Let your eyes move over the crystals and select the first one which you are drawn to. It may take a while to get used to seeing when a crystal is the right one for you, but gradually you will pick it up. Sometimes you will not see a crystal which you want to take home, and other times the shop will seem to sparkle as each crystal's aura glows. Open your heart and your mind and you will find it becomes easier,and that the crystals will talk to you.
3. Take your crystal home and cleanse it. It is important to cleanse your crystals regularly, but even more so when you first buy the stone as it may have been handled by many other people. Probably the easiest way to cleanse crystals is to place it in the light of the full moon, which helps to remove negative energy and recharge the crystal. If a crystal needs a very intense cleansing,bury it between the roots of a tree, but remember to mark it so you can find it later.
4. After cleansing, you are free to work with your crystals as you wish.

## Tips

- Some stones never need cleansing, including Kyanite and Carnelian.
- You will find your own favourite technique to choose crystals. If you want to, you can try scanning your left hand over the selection and feel which stone you are drawn to.
- If you need to cleanse a crystal quickly use a visualisation. Hold the crystal in your hand and breathe onto it, visualising the black negative energy flowing away, as golden/white energy flows into the stone.

## Warnings

- Never haggle over the price of a crystal.
- Some crystals are will fade if they get too much sunlight, others are damaged by water- if you aren't sure, double check!
- Crystals may vanish once they have done the work they need to in your life.

- Only use crystals with pure intentions, and never to try to harm others with the stones energy.
- Some people may find it funny if you talk to crystals!
- If there is a life-threatening emergency, call 911. Do not rely on a crystal to save a life in an emergency. They do not heal severe trauma, nor can they reliably save lives with serious wounds. Call an ambulance, and get professional medical help.

# How to Circular Breathe

To blow air constantly through their didgeridoos, the ancient aborigines of Australia created and perfected the art of circular breathing. Nowadays the most famous circular-breather is Kenny G. To learn how to circular breathe, kindly inhale this article.

## Steps

1. Puff your cheeks with air so that they are full, but you can still breathe through your nose.
2. Now, let the air out of your mouth while plugging your nose.
3. After you get that feel, do the same thing without plugging your nose.
4. Finally, push the air out of your mouth while breathing through your nose, until you get a rhythm, then strength in your breathing will come.

## Tips

- Try step one and step two with water in your mouth.
- Get a glass of water and a straw. See how long you can continuously blow bubbles.

## Warnings

- Only try this for a minute or two at a time. Stop if you feel lightheaded.

# How to Combat Eczema Naturally

Eczema affects people of all ages, and can cause misery. Doctors often prescribe a steroidal cream, which for many people doesn't always do the trick. There are other things you can do to ease the terrible itching and blistering.

## Steps

1. Eat more alkali-producing foods. See below for website links with food charts of acid/alkali foods.
2. Try a non-prescription steroid cream containing hydrocortizone, first. There are many anti-itch/anti-swelling creams, and some work better than others for different people.
3. Talk to your doctor about getting something stronger, if nothing seems to work.
4. Take a natural Kelp supplement which you can find in most health stores. It is a small pill which reduces the levels of acidity in your body.
5. Avoid lotions that are heavily perfumed. These can irritate your skin.
6. Look for creams that contain Neem oil - this is reported to be very effective for eczema. You may have to try a natural foods store to find it.
7. Aloe Vera Barbadensis Miller is also known to help Eczema and is in many products.
8. Foods such as salmon and other fish may help, too (because they contain fatty omega acids).

# How to Count Calories for Food

Where to go to find the best information on food.

## Steps

1. Determine exactly what is the the food item. Write it down, and be sure to include toppings, dressings, cheeses and so forth.
2. Go to CalorieKing.com, or another similar website and enter what you ate. That should give you the answer unless the calorie count for that item is not on their counter.If you can't get the information you need on this site then..
3. Go to a search engine, and type in "Calorie Amount for: (blank). It should come up.
4. If the food item is from a national food chain (even local sometimes) you can check out their complete nutritional menu online. (Wendy's; McDonald's; etc.)

## Tips

- Every food item you purchase has the calories on the package.
- Get a little book, and write down the calories you are using from everything you eat during the day. Count them at the end of the day.

## Things You'll Need

- A Computer
- A full (or soon to be full) stomach
- pencil and paper to write the calories into

# How to Create a Self Hypnosis Recording

If you find it difficult to do self hypnosis then try making your own self hypnosis recording and see what a difference it makes when you listen to your own recorded voice. Generally, you don't need to be a deep trance state to achieve a positive outcome. Being in a trance state is something like a 'day-dream', it's not the same as being in a deep sleep. Often, you will be aware of the things going on around you.

## Steps

1. Firstly, you will need to write or acquire the following hypnosis scripts and then record them in this order listed below. *(If you wish to write your own scripts it would be best if you were a qualified hypnotherapist - however, there are many free professional public domain scripts available, check the links at the bottom of the page).*
    - **Induction Script** - this is the initial relaxation script. An induction is to help you 'induce' relaxation. For example, the script may ask you to close your eyes and relax your scalp muscles. In this case, (& there are other styles of induction scripts,) the script may start at the scalp, to muscles at the back of the head, the muscles around the eyes, cheeks, the jaw, neck... all the way down to the tips of the toes. Just follow the suggestions, and allow yourself to relax.
    - **Deepening Script** - allows you to relax deeper than you were during the induction phase. There may be suggestions such as 'as every minute passes', or 'every noise you hear allows you to relax deeper than before'. A popular deepening script is to 'imagine three steps that take you down... and with the first step you take, now, relax much more than you were just a few moments ago...'
    - **Subject Script** - This script will have suggestions to assist you to achieve your objective, whatever it may be. Look for positive suggestions that work with your imagination, as opposed to ones that say you will do 'this' or you will do 'that'. Generally, positive suggestions such as imagine yourself in a situation where you are a non-smoker is preferable to "cigarettes make you feel ill" - while it may work to help stop you smoking, it may also cause a reaction when, for example, you might be on a crowded train and smell cigarette smoke on a person nearby...
    - **Awakening script** - This script will bring you back to full awareness. An awakening script ofen involves a count from one to five, and to allow the 'energy' to return. Should you record one such as this, when you count 'up' from one to five make sure you increase the energy in your voice so that you come back to full conscious awareness full of energy and vigour. (There is an alternative to the 'Awakening Script' and that is by recording a script to enable you to drift off to sleep. This may be a preferable

alternative for those who are doing a self hypnosis recording to assist with sleep or insomnia).

2. Record the scripts to a suitable equipment in a quiet environment. (Check tips and warnings.)
3. Once you have recorded them play your recording back to yourself. Test it out by finding a quiet, comfortable place; close your eyes and simply follow your suggestions.
4. Remember, you have recorded the script for you so allow yourself to really get involved.

# Tips

- While this is not strictly 'self-hypnosis' it is 'self' hypnosis!
- When Recording, be aware of:
    - The use of suggestions - Make sure you have a suitable script for what you are trying to achieve.
    - Your tone of voice - ensure you sound calm and confident.
    - Your speed or pace - don't race, it's OK to proceed slowly, in fact it is probably preferable.
    - The inflection of your voice - don't drone on, but don't over do it, either.
    - The emotion in your voice - too little will appear cold, too much comical.
    - Overall, your presentation is to create relaxation.
    - Add energy to your voice during the "Awakening Script"
    - Perfect practise make perfect.

# Warnings

- Should you add music, your choice of music must not include copyright material. (No! not even for yourself.)
- Do not use copyrighted scripts - there are many in the public domain. (See below.)
- When recording be aware of background noise - you will hear it on playback.
- (**WARNING** - Sony NET MD mini disc players are NOT capable of digital transfer to PC even though it has a microphone port.)
- Self hypnosis is not intended to be a substitute for seeking medical advice or visiting: a medical practitioner, clinical hypnotherapist or any other relevant health or alternative health therapist. If you are receiving treatment for clinical depression, bi-polar, schizophrenia, or any other diagnosed disorder, you must discuss using hypnotic scripts from this, or any other site with your health practitioner before you commence any hypnosis or self hypnosis sessions.

# Things You'll Need

- Printed out Induction script.
- Printed out Deepening script.

- Printed out Subject script.
- Printed out Awakening script.
- Something to record to: Tape/dictation machine, PC/Mac with suitable recording software or MD/Mini Disc player, (note warning,) or MP3/WMA recorder.
- Quiet place to do the recording - watch out for background noises.
- Quiet place to listen to your recordings

# How to Cure an Earache

For mothers of young children, there are natural methods for relief of earaches. It has been estimated that as many as 95 percent of all children have at least one ear infection by the age of six. Believe me, there is nothing worse than walking the floor with a child suffering from an earache. This is what my family has always used for an ear ache that is a result of an ear infection.

## Steps

1. To alleviate pain, place a few drops of warm olive oil in the ear. Bottle can be placed in a small glass of warm water for a few minutes to get it warm.
2. Plug the ear loosely with a cotton ball.
3. You can also make a paste using onion powder and apply it to the outside of the ear to relieve pain.
4. Apply a warm compress over the painful ear. Heat can bring quick pain relief.
5. Garlic oil and Mullein flower oil can be used as an alternative to olive oil, either in combination or on their own. They will help to fight disease-causing microbes and reduce inflammation. Place a few drops of oil in the ear twice a day.
6. If the outer ear appears irritated, Lavender oil rubbed in gently can be very soothing. Apply as needed throughout the day.
7. Prepare a steam inhalation by adding several drops of Eucalyptus essential oil or a teaspoon of Vicks to nearly boiling water in a bowl. Place a towel over your head and inhale the steam through the nose 3 times a day until pain subsides. This will help to open the Eustachian tubes, easing pressure and help to drain the fluids from the ear.
8. Supplements such as Vitamin A, C, and Echinacea will help boost the immune system.

## Warnings

- Avoid the most common allergenic foods: wheat, dairy products, corn, oranges, peanut butter, and all simple carbohydrates, including sugar, fruits, and fruit juices.
- Do not blow nose if you have an ear infection. Keep the ear canal dry.
- Put cotton in the ear canal when showering or bathing.

- Never insert a cotton bud (Q-tip) into the ear as this can puncture the eardrum.
- When using a steam inhalation, put the bowl into the sink to prevent accidently tipping the bowl over and burning yourself.

# How to Detox

Note that this article contains information on detox in order to pass a drug test - not to really cleanse your body. Don't read the article if you are interested in the latter.

Ultimately, the most important steps to detox are liquid going in and sweat going out. Urination is key too. Depending upon what exactly you're purging from your system, you might want to mix in some special detox substance which can be purchased at any body-building or exercise store.

## Steps

1. Drink as much cranberry juice, water, and apple cider vinegar (the latter can be the least consumed) as you possibly can. Walk around with a glass/bottle in your hand for a week. Don't stop drinking and peeing!
2. Exercise, exercise, exercise. If you have a month to detox, stop doing whatever it is that you need to get out of your system (Maryjane will always be there, you can tell her to go on vacation for a month if necessary). If you have a week to detox, go run! If you don't like running, pump iron vigorously (not painfully though, this is worse than not passing a piss test) or play soccer or have a lot of sex. WORK UP A SWEAT EVERYDAY.
3. Stay away from your friends if they don't need to detox and they continue to do what you need to stay away from! White, maryjane, beans - stay away! Jane is the most difficult to purge from your urine, and white is the most difficult to purge period (in addition to a few other hard substances) because it stays in your hair follicle/strand.
4. Find out how you're being tested. If it's a piss test, no problem, follow the above steps. If you don't know the manner of testing, just buy a bus ticket.

## Tips

- Stay calm. The worst thing is a nervous test-taker. And do NOT use any other liquid to substitute as urine. Bad idea.
- Lighter Japanese food like Miso soup, Sushi, and Green tea are very de-toxifying. There's a reason Hiroshima bounced back quicker than Chernobyl.

## Warnings

- You can always buy the semi-expensive "Detoxification Beverages" and so on, BUT do some research into which ones work and which ones just leave you screwed. I know some of them are just rancid milk - not really, but it's funny. GOOD LUCK!
- If you discover that the drug test to be administered involves hair chromatography, you may attempt to depilate your entire person to evade conviction and condemnation. Drug testers are wily to your grin, and will assuredly try another method. Do not read this warning, panic, go further and exsanguinate yourself, as the ramifications thereof are likely more costly than those of a failed test. Perhaps stray even from shaving off all of your hair. Believe me.

# How to Do a Hard Core Advanced Therapeutic Massage

An advanced technique to help ease body pains and promote relaxation.

## Steps

1. These therapies will not diagnose or cure; they will help you promote good circulation, helping to make your muscles become more pliable and hydrated. Range of movement can be increased and you should feel less pain in your muscles.
2. Start with face-up chest, their arm down to side. Prop their arm up on your knee or pillow to loosen the pectoral, anterior deltoid area to work through it more easily. You can start at the center of their chest by the clavicle and work towards you to clear the area thumb-width by thumb-width like combing through their muscle bit-by-bit. Then change their arm position to above their head and prop it up again; this changes the fibers of each muscle area, go through the area again for a more detailed, deeper affect. Place arm down to the side and go through again.
3. Next: arms, biceps worked both from and to the heart several times over. Forearm flexors and extensors and then the hands, working with steady pressure in the palm, and gentle twist/pull for each finger.
4. Next: thighs. Top of legs, to and from the heart, you can face your body to their face and turn toward their feet when you change direction to make it easier for you. Working knee to hip then hip to knee, then knee to hip slowly clearing the muscles deeper as they let you go through, like a wave in water, letting the muscle relax and move as you go through with your thumbs. If you work the inner or outer thighs, proceed with care, as they tend to be quite sensitive.

5. Optional: Abdomen and Hips. If you work this area, you must be patient and gentle, as it tends to be sensitive. Start at the bottom of the ribs on the left and right abdominal muscles and work your way down to a couple inches above the front of the pubic bone, then work back up. Then slowly go back down and up a bit further out; repeat until you get to the obliques. Also work gently inside the iliac crest, and you can work quite a bit on the outside edge of the hip between the iliac area and the joint at the head of the femur. At this point, have them turn over.
6. Once they've flipped over to face down, start again with their legs straight, knee to hip, and then hip to knee and back to hip. Calves the same way, including the muscles lateral to the shinbones in front, then feet; they are easier since the bottom of their feet can be propped up on a firm pillow. Use a couple run-throughs of increasing pressure in the arch and ball of the foot, then the toes as done to the fingers; You can have them turn their knee out and bend their leg out so that their illio-tibial band is up to work on; this also changes their hip to work on again around their trocanter (leg bone). End with their legs straight of course.
7. Hips again now, if no underwear, uncover just one hip and work on separate to and from heart slowly clearing deeper each time.
8. Now move to the back, warm with lotion or oil feeling for tight areas to concentrate on and them have them scoot down and turn to a side. You can start with their shoulder or hip, it doesn't matter, all will be worked on. When a person is turned on their side, the muscles change their structure, some loosening, some tightening, work on the loose muscles deeper and slowly, concentrating and clearing those areas. Have them place their arm down to side to get at infraspinatus and rear deltoid easier; this also loosens trapezius as well. Carefully work and loosen the side of their neck on top, then have them turn their head so that their nose is down toward table and work the underside of their neck, by turning their head it puts a slight twist in the neck and shoulder muscles to catch and go through slowly and more thorough. Have them turn their head back to a comfortable place to go again through the shoulder, then lats, then rib cage and quadrattus lumborum, by working this area from the side you can slowly sink through and clear to spine.
9. You can work through hip again from this angle too, then to have them turn over to repeat on other side.
10. When done with that side, have them face down again to work through their entire back again and finish with the shoulders and neck,to help maintain a relaxed state.
11. You can have them flip over one more time to face upwards, and finish with the muscles of the jaw, face and head. Here, start at the temples and work your way out, then through the ocular region, down onto the cheeks and jaw, and where the jaw meets the neck below the ears. Then work outward from the center of the forehead, and slowly running your fingertips longitudinally around the skull from front to back.
12. It may take a while to get used to doing this massage technique.

# Tips

- Remember this technique cannot cure illnesses but may help you deal with them.

- Remember music, preferrably something that is mellow.
- Always back your hands up. This means always have one hand support the other, it is like a one-handed massage at times but only when you are working deeply and then for medium to light work you can use both hands separate.
- Massage oils and lotions work great. Warming them will also help relax the muscles. Do not warm oils to the point that they will burn or scald. (Follow instructions presented on the bottle.)
- Since the touch given in massage can be an intimate experience, be sure to pay attention to the receiver's boundaries. If in doubt, ask "Is this okay?"
- Every person has different thresholds for pleasure/pain. Encourage the receiver to give feedback on what's good or if anything hurts, and then listen.

## Warnings

- This can be very habit forming.
- Be aware of any signs of contraindications. These are warning signs and **should not be massaged**. (see external link for list of contraindications)
- When using oils or lotions, follow any directions and advice given on the bottle. Do not use oils on areas with a large amount of body hair - this can cause irritation at the base of the hairs.
- This How-To is not a substitute for actual massage training, and should not be used as treatment for injuries. A trained masseuse/masseur should be sought.

# How to Do a Natural Detox

When you detox your body you're allowing the liver to rest and recuperate while nourishing your body with essential vitamins, minerals, phytonutrients and other nutritional substances that are important to good health and vitality. You are also drinking a lot of water which helps to re-hydrate your cells and flush out toxins.

Here there are some ideas for a mild general system cleanse that you can implement to detox your body. Follow these steps from two to fourteen days:

## Tips

- In the book entitled "Baths to Detoxify" Dr. Hazel Parcells, ND., Ph.D., recommends a bath for general detoxification that is very helpful and easy to follow. This bath helps to increase the acid level in the body and build immunity. All you have to do is...
- To fill your bathtub with hot water, as hot as you can tolerate. Add and mix 2 cups of pure apple cider vinegar and stay in the bath until the water cools down; do not take a shower for at least 4 hours. Dr. Parcells recommends taking this type

of bath before going to bed so your body detoxifies while you sleep. You can repeat it as many times as you feel it's needed, even once a day.
- Also you can...
- Drink plenty of water; eight to ten glasses a day. Distilled water is good but do not drink it for more than 14 days consecutively. You can use filtered or Reverse Osmosis water the rest of the time.
- Squeeze the juice of one-half lemon into the water every time you drink it. Do this for 7 days and then cut back the remaining days. Only use the juice of ¼ of the lemon and only in one glass of water a day.
- Have 10 gr. of soluble fiber before going to bed. It can be oats or psyllium.
- Eat light and include lots of fresh raw fruits and cruciferous vegetables during the cleansing. Do not consume heavy proteins as they slow down the detoxification process.
- Eat nuts and fish as your protein source. Fish provides Omega-3 and nuts provide many vitamins including B, E, magnesium, potassium as well as antioxidants such as selenium. Selenium is a potent antioxidant that is essential in the detox processes.

## Warnings

- Rashes, diarrhea or nausea may occur when following a detox diet. These are normal symptoms that indicate the body is getting rid of unwanted toxins.

# How to Enhance Your Breasts with Exercise

Breast enhancement exercises are perhaps the cheapest and most natural method for promoting breast growth although they require a dedicated approach to make them work. The most popular breast enhancement exercise is a push-up. Here’s the right way to do push-ups:

## Steps

1. Lie facing down on your stomach on a flat surface
2. Bend your knees and cross your ankles.
3. Now start bending your elbows while keeping your palms in line with your shoulders.
4. Remaining balanced on your palms and elbows raise your body - keeping your ankles crossed. This way, you don't raise too much weight. Don't straighten your elbows when raising the body - it may cause damage to your joints.
5. Slowly lower your entire body, but don't lie down. You should decrease the angle only until your arms become in line with the floor.

## Tips

- Breast enhancement exercises, like any form of exercise, should be performed in sportswear, on a comfortable flat surface.
- If done without caution, these exercises can strain the muscles, so speak to your doctor first if you have any concerns.
- Don't push yourself too hard, and stop immediately if you feel unwell, be it pain or tension.

# How to Extract Bad Cholesterol from the Mouth

REDUCE THE BAD CHOLESTEROL FOR GOOD HEALTH AND A LONG LIFE

## Steps

1. as the mouth is the origin of bad cholesterol
2. and the source of epithelial cholesterol cells.[BAD]
3. and the cells sloughed off from linings of the mouth
4. the mucous membrane,collect the cells,failure to clean
5. membrane, you will digest the bad cells,
6. you will have to extract the cells, in the mucus on
7. the mucous membrane that very sticky
8. to do this a grape juice or vinegar mouthwash
9. of about eight ounces gargle, hold, gargle each ounce
10. the acid in the mouthwash, changes the sticky mucus
11. to a liquid
12.
13.

## Tips

- mouthwash before you eat
- after dinner
- wash mouth
- use white vinegar,add instant coffee for better taste
- 6 ounces for 64 ounces of vinegar and boil
- 2 OUNCES OF 64 NIX WITH 8 OUNCES OF WATER FOR MOUTHWASH

## Warnings

- A DRY MOUTH LATER
- MOUTHWASH AFTER DINNER, 5-6 HOURS BEFORE BED

# How to Get Sound Sleep

You can get sound sleep.

## Steps

1. Exercise daily.
2. Go to bed at a reasonable hour so you are not restless.
3. Sit in meditation for at least five minutes, remember nothing, there should be a vacuum in your mind. Or you can breathe in, hold it for a second and breath out; do this for five minutes.
4. Drink a cup of milk before sleeping.
5. Do not eat beef or pork meat in the evening.
6. Do not eat at least three hours before sleep.
7. You will get a good night sleep.

## Tips

- Find and get rid of things that make you uncomfortable when you are sleeping, such as an open window or the washing machine in the hall.

# How to Get Through PMS

This is the second worst (and for some, the worst) time of month. It's horribly miserable! There are 78 different symptoms of PMS, the most popular being headaches, bloating, tiredness, and food cravings. Eighty percent of women who are of child-bearing age experience PMS on average of 400 times in a lifetime. If you're embarassed, don't be. It is normal to be snappy when you don't feel good. Your priority should be to focus on your health and to act as normal as possible. Most of these steps are general advice for any time you feel stressed, tired, or experiencing personal burnout.

## Steps

1. If you suffer from menstrual cramps or any other physical pain during PMS, purchase Midol or Pamprin. Hot tea, hot showers or baths can raise body temperature to reduce cramps.
2. Follow your cravings but try to limit yourself to the small size of fries, or one piece of chocolate instead of the supersizes or whole chocolate bar.
3. If you cry, think about why you feel this way. There are studies that show that women release more stress chemicals through tears than men. Try not to elevate your mood through food or shopping, because the effects are only temporary.
4. Sleep more and treat yourself. This is the perfect time to get a manicure, facial, or haircut.
5. Let the dry cleaners do your laundry.
6. Order in Chinese food.
7. Watch comedy.
8. Create your own mini-spa. Relax with a glass of wine, a candlelit bubble bath, and Barry White (or other easy listening).
9. If you're married, let your spouse know- as a warning.
10. Drink more water and take a calcium supplement. This helps with cramps and overall achiness.
11. Dress with more flair! People will notice and give you more compliments, especially if you wear a color, material, or clothing cut that flatters your shape. No matter what you choose: whether it is cute shoes, a sparkly pair of earrings, or a new updo, make that one accessory special!
12. Be sure to smile and compliment people as well. Studies show that even faking a smile reduces stress and puts you in a slightly better mood. Most people cannot tell if you are faking anyway.
13. Have a girl's night out. They'll understand.
14. Think before you speak, but don't overthink what you say to others.
15. Exercise. Honest. It'll make you less cranky.

# Tips

- Don't plan to quit smoking, lower your starchy carbs, or cut caffiene cold turkey at this time. This will throw your off-balance hormones even more out of whack. Timing is everything, and there are better times to majorly adjust your lifestyle.
- Screaming never helps anyone unless they are really in danger. If you feel the urge to scream at people, get away and write your problems down. It takes discipline, but your thoughts become much more organized on paper. You might discover that the real reason you hate your coworker is that they don't understand your reasoning, philosophy, or what's bugging you.
- This is a time that you are much more sensitive to your feelings. For example, if you can ignore that you hate your job for the first two weeks of the month, then PMS week is the time that you'll most likely feel depressed by it. If this is a sore spot for you, then write down why you get up and go to work, however insignificant. Finding that you like the people, the work, or even the paycheck can ease the mental stress of a poor job fit. If you write down what bothers you, then you'll be more motivated to change that part of your life.

- If there is something about your significant other, parent, or friend that really aggravates you, gently confront them about it without criticizing them. These are the people who love you, and as such, should be willing to listen or at least be aware of your hangups or issues with them. See Warnings.

## Warnings

- Consider writing out what is bothering you about these people. This may not be the best time to confront them.

# How to Get a Good Night's Sleep when Your Imagination Runs Wild at Night

Having an active and creative imagination is a great gift. However, at night it is sometimes not so great, but can be quite miserable. However, do not despair, as there are ways of dealing with this problem. This article will introduce a few ways of dealing with the problem.

## Steps

1. The most traditional way of dealing with an over-active mind late at night is to count something. Sheep are very popular for this purpose, but most things will do. The logic behind this approach is that it bores you into falling asleep. Thus boring things (such as sheep) are better.
2. A second method is to focus on one, boring thing, with the purpose of stopping your mind from running so fast. This requires more practice, as your imagination may not be pleased with this. It is particularly useful to focus on something that is far away from your head, such as the tiniest toe on your left foot. Try to feel your toe, and think only about the toe. If you slip up, return to the toe.
3. It is also possible to try to calm down your mind before going to sleep. Doing a crossword puzzle, sudoku, or reading a little may calm your mind down so that you fall easily asleep. Note: for some people this has the opposite effect, making them more awake.
4. Instead of focusing on your mind, you may wish to focus on your body. Doing some excercise (such as running) earlier in the evening, or some yoga right before you go to bed will make your body sleepier.
5. Take up meditation, and practice before you go to sleep. Meditation calms the mind, and some types of meditation teach you how to clear your mind completely.
6. Try creating a very detailed story to yourself, something that interests you. You will fall asleep far before you come to the end of the story.
7. Concentrate on each breath you take. Breathe more slowly, and enjoy each breath, concentrating on how good it feels to be able to breathe. When you slow your

breathing, this tends to slow your heart rate as well, which ultimately calms you down.

## Tips

- There are also medicines (both traditional and alternative) that are intended to help people fall asleep. While traditional medicine work on the body through chemicals, certain alternative medicines try to deal more directly with the mind. An example of the latter would be the Homeopathic remedy Coffea, which calms an overactive mind.
- Reduce your caffeine intake.

## Warnings

- Insomnia can be serious problem, and if you believe that inability to sleep is negatively impacting your health, you ought to see a doctor.

# How to Get a Shot

Getting shots are not easy but here are some tips to ease the pain.

## Steps

1. Tell the doctor that you want to say 1, 2, 3, and then have him or her give you the shot.
2. Even if the shot hurts, try to move your legs or arms around because that will get your blood flowing.
3. Avoid looking at the needle at all costs, especially as the injection is taking place.
4. Get a drink of water before or after you get the shot because that will help if you're not feeling well.
5. When you leave, warn your family that you got the shot so they do not play rough with you.
6. Get your doctor to prescribe Emla cream to you and apply it before getting the shot to numb the area.
7. Remember that shots are not all that bad! They are just a quick pinch that you barely feel.

## Tips

- Try to squeeze something when you get the shot.
- Try to look at something and concentrate on it while you get the shot
- Ask the doctor to give you the shot in the arm you write with. The soreness will be less the more you move it around.

## Warnings

- Do not run away from the shot; it could be dangerous! Besides, you're going to have to get it eventually.
- Don't kick the doctor

# How to Get to Sleep, and Stay Asleep

Can't sleep? Restless nights? Here are some get-to-sleep steps that'll keep you sleeping all night long.

## Steps

1. Practice good "sleep hygiene". Get yourself ready for sleep by relaxing a few hours before bedtime -- take a bath, drink some warm milk or herbal tea. Generally the room in which you sleep should not be overheated...your body temperature drops as you sleep and for most people a cooler room is best. Turn down the lights and try to spend your final hour before going to bed in reduced lighting.
2. Turn your alarm clock away from you so that you cannot see the time. Avoid knowing what time you went to bed or took a nap.
3. If you are worried about tasks for the next day, make a written list and place it near your bed - this will "free" your mind from worrying about tasks you "need to remember" and thus reduce your stress level about sleeping.
4. Make sure you have a comfortable bed in which you can get a good night's sleep.
5. Position yourself comfortably on your back in bed, with your arms by your side. If you are uncomfortable with any way your body feels on the bed, correct it immediately, e.g., your body's weight on your arm is too strong, or your hip feels awkward---change position quickly until you're completely comfortable.

6. Close your eyes.
7. Move your tongue so that it rests on the bottom of your mouth.
8. Open your mouth slightly.
9. Open your hands if your fists are clenched
10. Starting from the very tips of your toes, imagine yourself sinking into the mattress.
11. In your mind, begin to "acknowledge" everything around you that all your senses are experiencing. For example: Say to yourself (not out loud), "I hear the clock ticking. I smell the lotion I just applied to my hands. I feel my legs' weight on the bed. I hear my spouse/partner breathing. I see different shades of black. I hear the dog barking in the distance. I hear myself in my own mind talking.", etc. This should help to clear your mind by slowly acknowledging everything and subsequently dismissing it.
12. Stay on your back, sunk into the mattress until you feel it is time to roll into your desired position.
13. Try relaxing each and every muscle in your body. Don't be tense.
14. Breathe normally.
15. If you must get up in the middle of the night (bathroom trip) try to keep light exposure to an absolute minimum (zero if possible). For some people, a urinal bottle near the bed may allow you to avoid bathroom trips (and possible exposure to light).
16. If you must have mild illumination in your bedroom (eg, glowing face of digital clock, night light), remember that red wavelengths of light generally are not as disruptive to sleep cycles as blue or green wavelengths.
17. Place a water bottle next to your bed. Some people find that if they awaken in the middle of the night a drink of water is refreshing and helps them drift back to sleep.

# Tips

- Wear comfortable, clean night garments, and buy a decent mattress. A mattress is worth more than you think, considering you use it every night, so don't hold back!
- When awakened in the night, try and keep your eyes closed and your mind clear, then simply drift back to where you were.
- There is an over-the-counter drug called melatonin that is incredibly safe (your body produces it naturally). Melatonin will help you fall asleep if you take it at the same time each day before you go to sleep. As we age, melatonin levels decrease so melatonin may be more helpful from an age related perspective. Some people may find taking melatonin in a "staged" manner helpful: take half a melotonin tablet before going to bed, and the remaining half if you awaken in the middle of the night.
- Many people find tryptophan (available in health food stores) to be a safe and reasonably effective sleep aid, probably due to its ability to increase brain levels of serotonin and/or melatonin Prescription sleep aids may be necessary for some

people and should only be used under a physicians supervision. Ambien and Lunesta are commonly advertised, but Sonata may be useful for those who fall asleep easily but may awaken early.

- Valerian, an over the counter herbal, may also be considered. Valerian has mild sedative effects and is generally safe for most people and appears not to cause grogginess upon awakening. However, some herbal literature indicates that if used for a period longer than about a week, the herb can have the opposite effects. Other herbal sleep/ relaxant aids to consider are: Lemon Balm, Chamomile, Hops, Kava Kava, and Catnip (which is especially safe and non-habit forming, and gentle enough for children). Talk with someone who has experience with these herbs or do some research.
- Lavender is well known for its sleep inducing qualities. Try a lavender neck pillow,or a few drops of essential oil on your pillow slip.
- Making your bed every morning will aid in not having to fight with your blanket every night.
- Music can help people fall asleep. However, if death metal knocks you out and you live in an apartment building, make sure there's a timer or the like on; your neighbors will thank you.
- If you have any questions or concerns, contact a physician or other health care professional before engaging in any activity related to health and diet. This information is not intended as a substitute for professional medical advice or treatment.
- Wearing a blindfold can help to put your mind to rest. On a subconscious level whether your eyes are open or closed, a blindfold tells your brain "nothing to see" and helps to relax.
- If you have trouble blocking out sounds around you (especially in an apartment building) then wear a set of earbud headphones to bed with some language tapes running. Listening to the language tapes provides you with a soothing voice that is talking in a very mellow tone and has the bonus of reinforcing your knowledge of the language while you sleep.
- If you lie awake in bed for more than 20 minutes get up, go to the couch and read. Train your body to associate the bed with sleep.
- If nothing works, get out a really boring book. Start reading it. You'll get bored of it and your brain will think "I'm getting tired of this book, I better go to sleep" It actually does work!
- Try to keep to a sleep schedule. Try to go to bed and wake up at the same time every day, even weekends. This also trains the body.
- Try an over-the-counter sleep aid. Unisom is highly effective (and addictive), just make sure you have a full 8 hours to sleep. Unisom and Sominex have the same active ingredient as Benadryl, but Benadryl (an antihistamine)is cheaper (especially generic). While Benadryl isn't addictive like Unisom, it can slow you down the next morning by making you feel groggy-headed. Look for natural sleep aids sold in health-food stores before trying Unisom.
- Try a two-week regimen to get your body into the habit. Create a nightly ritual, brush your teeth, bathe, etc. Utilize sleep aids and the tips above for the entire two weeks, going to sleep at the same time every night.

- Adjust the temperature so it is cooler than usual, but not too cold. Make sure to stock up on blankets if you do this.
- Use your imagination to start dreaming (i.e. picture yourself on a beach).
- Drink warm milk or herbal tea.
- Try counting backward from 1000...you won't get far.
- Count sheep... but not the bouncy ones. Imagine a peaceful meadow with rows of sleeping sheep. You are gliding above them (peacefully) and you can count them to relax.
- Try to keep a regular sleep schedule. When your body gets regulated, it won't have a hard time getting to sleep.
- Make notes if you discover patterns of sleep or going to bed that work. For some people, sleep can be highly ritualistic...cultivate the rituals that produce your best sleep experiences.

## Warnings

- Without a clear mind, you cannot sleep well.
- If your feet are cold, sleeping is much more difficult.
- If you have trouble sleeping over an extended period, seek medical help.
- Do not take sleep aids -- even 'natural' products -- if you are on other medications, pregnant or nursing. It is always best to consult your doctor.
- Do not have any beverages 2 - 3 hours before sleep that contain caffeine or taurine. Some studies have suggested that caffeine as early as noon can disrupt sleep cycles in sensitive people.
- When in bed, don't put the TV on. Make sure there are no distractions. A bedroom should only be used for sleep and sex.
- Don't expose yourself to bright light as that wakes you up and lowers the quality of sleep that you do get. Even *brief* exposures can "reset" your sleep cycle.
- Avoid cat naps during the day. Even 15 minutes can severely disrupt sleep schedule later that night.
- Upon awakening, try to get exposure to daylight (or blue wavelength light) to help "set" your awake portion of the day.
- It is easier to sleep in a cool room than in a warm room. Use a light cover.
- Don't think too much about what time you have to get up in the morning.

## Things You'll Need

- A bed
- Yourself
- Lavender oils
- A pillow

- a blindfold
- music (not too loud)
- warm socks
- blankets

# How to Go to Sleep when You Aren't Tired

You know you have to get to sleep, but you feel like you could run a marathon. You know you'll regret it if you don't get to sleep. So here's how you can:

## Steps

1. The brain has evolved to remain awake when it is needed—or thinks so. If you are not naturally tired from physical exhaustion, you can induce drowsiness through either medication or psychological conditioning:
2. **By Psychological conditioning:**
    1. Think of an activity you found boring or tedious but not especially demanding or strenuous. If you don't like reading encyclopedias, that would be a good example.
    2. Perform that activity immediately before going to bed. The boredom produced will lower your brain's natural level of arousal to something closer to sleep.
    3. Your mind will likely have random thoughts flow in and out. Mildly pleasant and relaxing thoughts are most conducive to sleep.
3. **Through medication:**
    1. Drugs classified as central nervous system depressants decrease the brain's activity. I strongly encourage using psychological techniques before relying on an external means of attaining rest.
    2. Alcohol is commonly used to "numb away" problems and enable sleep, but nowadays there are depressants that work well for inducing drowsiness without the baggage associated with drinking.
    3. Anxiolytic drugs and sleeping pills have similar physiological effects as alcohol but come in a convenient pill form. After taking the recommended dose, you will notice your heartbeat and breathing slow; this should be accompanied by a feeling of drowsiness.
4. Now you should be able to fall asleep. If you still have trouble, see a doctor.

## Tips

- Sometimes counting sheep works, sometimes it doesn't.
- Everyone has a different bed ritual. what works for me may not work for you.
- The key thing is to avoid anxious brooding while you try to fall asleep. Mildly pleasant, relaxing thoughts or simply tedious, boring thoughts (like counting sheep) are a good replacement if your mind **has** to be thinking something all the time.

## Warnings

- Take care to read all directions and warnings for any medication you may take carefully.

# How to Grow

What you do when you're young will likely affect how big and tall you grow to be.

## Steps

1. Drink lots of milk.
2. Get lots of sleep.
3. Do not drink caffeine.
4. Eat healthy foods.
5. Get a cat or dog (they are proven stress relievers, and stress stunts growth).
6. Do not lift heavy weights.
7. Stand straight and keep a good posture.
8. Think positive thoughts.
9. Take your vitamins!
10. Get bone surgery to increase height

## Warnings

- Surgery is expensive and dangerous! Think long and hard about it!

# How to Grow Taller

There isn't much you can do to grow taller, but these tips can't hurt.

## Steps

1. Eat a well-balanced diet that is rich in calcium and iron. This can help promote growth if you are still young.
2. Take up yoga. Some people report that the stretching has helped them grow taller.
3. Stand up straight. Good posture can make you look taller.

## Tips

- Take time out to research foods that are rich in calcium and iron.

## Warnings

- Remember that you probably can't grow significantly taller. Try to be happy with your natural genetics and don't fight too hard!
- Taking lots of calcium without vitamin D is useless. You need vitamin D for absorption of calcium!

# How to Have More Endurance

Have you ever felt like you did not have the endurance to save your own life? Building endurance takes time, patience and determination.

## Steps

1. One way to build endurance is to move more efficiently. Tai Chi and Yoga can help with energy conservation
2. Check with your physical therapist or doctor to make sure that it is safe before beginning a new exercise program, even if you have been doing other activities.
3. The times and distances given below are completely arbitrary. You may need to begin building endurance at a lower level and progress much more slowly than the scheme suggested below.
4. To build your cardiovascular endurance you have to begin at a slow pace, some begin walking 5 minutes then run 1 minute the first few times, then walk 3 run 2, etc until you reach a point where you are running the entire time. Start with short runs, don't go to far from home because you will have to come back and if you get too tired you will put yourself at risk for injuries.

5. If you have access to a track at school or local park, start by walking 100 meters and running 100 meters, then increase the run by 50 meters and decrease the walk by the same number, etc.
6. Warm up and do a light stretch routine before you begin and then follow the workout with a cool down and a longer stretch. Hold your stretches for 10-30 seconds each.
7. If you experience joint pain or other discomfort in your knees, back, ankles - stop what you're doing, stretch and take a break. If the pain persists, see your Physical Therapist or Doctor. Sometimes knee pain can be related to problems with your feet or your back so it's good to see a doctor before self medicating.
8. Once you are able to run the 1/4 mile track without stopping, you can begin to increase either the speed in which you run it or the distance by 50-100 meters.

## Tips

- Drink water before, during and after your workout.
- Eat a diet high in complex carbohydrates to help you with energy.
- Avoid eating heavy meals up to 2 hours before the run.
- Successful results require progressive but consistant work

## Warnings

- No Pain No Gain is a myth - there is a difference between muscle soreness and pain. Consult a physical therapist or physician if pain persists

# How to Help Unhealthy People

Many people all over the world are dying of health problems. You don't want to be one of them so you should help people who have health problems. Both kids and adults necessitate facilitate and both kids and adults can help the unhealthy people. Soon this world will be safer and healthier.

## Steps

1. First, you should go to a neighbor and help them out.
2. Next, you should give them advice what is healthy or not.
3. After, you should help a neighbor exercise.
4. Then, you can train a neighbor older than you what is accurate and what is not.

## Tips

- You shouldn't go rigid on the people you are training
- You should also make a fund for a hospital for all the people who need help.
- You should never ever tell them it is hopeless, because when you say that word it will turn out hopeless
- Lastly, tell how better they are doing the exercise every day, don't turn them down.

## Warnings

- You should never make the work in excess of.

## Things You'll Need

- You will need a enormous heart

# How to Give a Head Massage

Give yourself a pleasurable relaxing head massage, all you will need is an old pair of glasses

## Steps

1. Find an old pair of glasses, sunglasses are fine, you may use the ones you wear regularly, but regular use may distort them.
2. Rub the ends of the glasses (the bits that go over the ear) lightly over your head.
3. Repeat as often as you like.

## Tips

- If you're feeling particularly brave, you may wish to construct your own massage device out of several pairs of old glasses.

- It's best for men to have short hair, as long hair can cause problems with flow.

## Warnings

- Don't poke your eye out.
- regular forceful use may damage your glasses.

## Things You'll Need

- Glasses
- yourself

# How to Improve Eye Sight

It has been suggested that this article or section be merged with *How to Exercise Your Eyes*. (Discuss)

Eye exercises can improve your eyesight.

## Steps

1. Stand about two feet from a doorpost.
2. Close one eye.
3. Hold a pencil up to the doorpost. Focus on the pencil.
4. Move the pencil slowly toward your nose, focussing constantly on the pencil. When the pencil touches your nose, move the pencil slowly back toward the doorpost.
5. Repeat with the other eye.
6. For the next exercise, move the pencil from left to right and back again. Focus on the pencil without moving your head.
7. Check your diet. On some days you will notice that your eyesight is worse than on other days. Try to remember what you ate that affected your diet: Eggs, chicken, milk, sugar, etc. Avoid the foods that worsen your eyesight. Eat the foods that improve your eyesight.

## Tips

- Some people use a beaded necklace, one end attached to the wall and the other end held up to their nose. They slowly focus on each bead from the wall to the nose and back again.

# Team Sports

## Bossaball

**Bossaball** is a mix of volleyball, football, gymnastics and capoeira. The court is a combination of inflatables and trampolines, divided by a net.

bossaball game

bossaball hang time : right before a smash

## Music and Sports / Samba Referees

Bossaball mixes sport with music. Bossaball referees have a whistle, a microphone, various percussion instruments and a disc jockeyset. They referee the game and control the soundtrack. Players play to the music / The music follows the game. Bossaball brings elements of capoeira, samba, breakdance, football, volleyball, acrobatics and circus together on a single pitch.

## Rules, Scoring, and Playing

Bossaball can be played in teams of three to five players. The aim of bossaball is for each team to ground the ball on the opponent's field. Each team is entitled to a maximum of 8 contacts with the ball on its own field, while the trampoline jumper gains height to prepare a smash. Any body part can be used. Players can touch the ball only once with their hands, or double touch it with their feet and/or head.

Once a team grounds the ball on the inflatables they gain one point. Scoring on the trampolines is worth three points. Hitting the bossawall - the red rings around the trampolines - doesn't count as a score, so the rally continues.

Bossaball shares game elements with Slamball and Footvolley.

# Rugby football

**Rugby football**, often just referred to as **rugby**, refers to sports descended from a common form of football developed at Rugby School in England. The two major sports are **rugby league** and **rugby union**. American football and Canadian football also originated from Rugby football. Rugby is the best-known of the British public school football games.

## Rules

Distinctive features common to both rugby games include the oval ball and the ban on passing the ball forwards, so that players can gain ground only by running with the ball or by kicking it.

Scoring in both games occurs by achieving either a try or a goal. A try *(at goal)* involves grounding the ball (touching the ball to the ground) over the goal line at the opponent's end of the field. A goal results from kicking the ball over the crossbar between the

upright goalposts. Three different types of kick at goal can score points: the goal kick after a try has been awarded (which if successful becomes a conversion); the drop kick; and the penalty kick. The points awarded for each vary between the games.

The main difference between the two games, besides league having teams of 13 players and union of 15, comes after tackles. Union players contest possession following the tackle: depending on the situation, either a ruck or a maul occurs. League players do not contest possession: play is continued with a *play-the-ball*.

Set-pieces of the union code include the *scrum*, where packs of opposing players push against each other for possession, and the *lineout*, where parallel lines of players from each team, arranged perpendicular to the touch-line (the side line) attempt to catch the ball thrown from touch (the area behind the touch-line).

In the league code, the *scrum* still exists, but with greatly reduced importance. Set pieces are generally started from the play-the-ball situation which has meant that rugby league has evolved into faster and more attacking game with a greater emphasis on running with the ball in hand, passing and scoring tries.

# History

*Football, History of rugby union, and History of rugby league*

Rugby School

The legendary story/myth about the origin of Rugby football—whereby a young man named William Webb Ellis "took the ball in his arms [i.e. caught it] and ran," showing "a fine disregard," while playing Rugby School's already distinctive version of football (not to be confused with association football, which was codified much later) in 1823—has little evidence to support it. Pundits have dismissed the story as unlikely since it was first

given the School's seal of approval following an official investigation by the Old Rugbeian Society in 1895. However, the story has entered into legend, and the trophy for the Rugby Union World Cup bears the name of "Webb Ellis" in his honour and a plaque at the School commemorates the "achievement".

Various kinds of football have a long tradition in England, and football games had probably taken place at Rugby School for 200 years before three boys published the first set of written rules (in 1845). At the time, a set of rules would be agreed between two teams before a match. Teams which competed against each other regularly would tend to agree to play similar rules. Richard Lindon (1816-1887), a Rugby-based boot and shoemaker pioneered the shape of the "oval" ball when he invented the rubber bladder and its brass hand pump, creating for the first time a standardization of the shape of the ball.

Rugby football has strong claims to the world's first and oldest football clubs: the Barnes Club (as it was known), formed in London in 1839 and the Guy's Hospital Football Club, formed in London in 1843, by old boys from Rugby School. However the continuity of these two clubs has not been documented. Dublin University Football Club, founded in 1854, is the world's oldest documented football club in any code. Other old rugby clubs include: Edinburgh Academical Football Club (1857-58), the oldest documented club in the UK); Blackheath Rugby Club (allegedly founded in 1858, although some sources suggest that the club did not start playing rugby football until 1862); and Liverpool St Helens Football Club (1858).

The Blackheath club also features in the history of association football (soccer): as Blackheath Football Club, it became a founder member of the Football Association (FA) in 1863. However, Blackheath withdrew from the FA just over a month after the initial meeting, when it became clear that the FA would not agree to rules which allowed running with the ball in hand (a fundamental part of rugby) and hacking (legal tripping). Other rugby clubs followed this lead and did not join the FA. Interestingly the clubs that did not join the FA and continued to play Rugby Football dropped the tripping rule and outlawed it.

By 1870 about 75 clubs played variations of the Rugby School game in Britain. Clubs playing varieties of the Rugby School game also existed in Ireland, Australia, Canada and New Zealand. However, they had no generally accepted set of rules: the clubs continued

to agree rules before the start of each game. On January 26, 1871, 22 clubs founded the Rugby Football Union (RFU), leading to the standardization of the rules for all rugby clubs in England. Soon most countries with a sizable rugby community had formed their own national unions.

Games based on rugby football became immensely popular in North America. However, by the 1880s these games had rapidly diverged from the laws of rugby used in most countries, and they became instead the basis of both Canadian football and American football. (See Comparison of American football and rugby union and Comparison of American football and rugby league).

The origins of the North American codes of football left lingering traces: the Canadian Football League's predecessor originally bore the name of the *Canadian Rugby Football Union* from its founding in 1884. Canadian football, was frequently known as "rugby" until the middle of the 20th century. On the setting up of the modern CFL in the late 1950s, it assumed control of the Grey Cup from an organization that still called itself the *Canadian Rugby Union* (now Football Canada, the country's amateur umbrella organization for Canadian football). Only in 1929 was the Canadian national rugby union formed — the predecessor of Rugby Canada.

In 1886, the International Rugby Board (IRB) became the world governing body and law-making body for rugby. The RFU recognized it as such in 1890.

The 1890s saw a clash of cultures between working men's rugby clubs of northern England and the southern clubs of gentlemen, a dispute revolving around the nature of professionalism within the game. On August 29, 1895, 21 clubs split from the RFU and met at the George Hotel in Huddersfield in Yorkshire to form the *Northern Rugby Football Union*, commonly called the Northern Union.

For clarity and convenience it became necessary to differentiate the two codes of rugby. The code played by those teams who remained in national organizations which made up the IRB became known as Rugby Union. The code played by those teams that played "open" rugby and allowed professionals became known as Rugby League.

NRFU rules gradually diverged from those of Rugby Union, although the name Rugby League did not become official until the Northern Rugby League was formed in 1901. The name Rugby Football League dates from 1922.

A similar schism opened up in Australia and in other rugby-playing countries. Initially Rugby League in Australia operated under the same rules as Rugby Union. But after a tour by a professional New Zealand team in 1907 of Australia and Great Britain, and an Australian Rugby League tour of Great Britain the next year, Rugby League teams in the southern hemisphere adopted Rugby League rules.

In 1948 a meeting in Bordeaux set up the Rugby League International Federation (RLIF) to oversee Rugby League world wide. From this meeting the first "Rugby World Cup" was played in France in 1954.

On August 26, 1995 the IRB declared Rugby Union an "open" game and removed all restrictions on payments or benefits to those connected

# Football

## How to Adjust a Football Mouthpiece

Recommended for most youth players under the age of 11. In order for a youth football mouth piece to protect, fit, and last, it must be worn properly on the teeth and gums as indicated in the fitting instructions. If any mouth guard is not worn properly and /or is chewed, its protection, fit, and durability will be greatly diminished.

### Steps

1. Fill saucepan with water. Bring water to a boil. Remove water from heat source. Let water stand for 30 seconds, then place football mouthpiece in water for 90 seconds. Do not exceed heating time.
2. Carefully remove mouth guard from hot water with a slotted spoon.
3. Cool mouth guard under tap water for one second only to bring surface temperature to a comfortable level. Quickly proceed to step 4.
4. Carefully place football mouthpiece around all upper teeth. Bite down firmly into mouth guard while, suck in strongly and use fingers to press edges of mouth guard into teeth and gum line through the lips and cheeks (continue for 20 seconds).
5. Remove the football mouthpiece and cool under tap water for 30 seconds. Replace into mouth and test for a good firm fit.
6. Repeat steps 1 through 5 if fit is not accurate

# How to Break Tackles in Football

When you see the defender running at you and you know you have to get the first down, what do you do? Break the tackle, that's what.

## Steps

1. Know your opponent well enough to anticipate his strength and the tackling technique.
2. If you are getting hit in the upper chest, push your opponent off with a stiff arm or simply duck down and get your center of gravity lower.
3. If you are getting hit stomach and waist level, it is best to keep your feet moving. Do not stop running. It is best to try and get to where you need to go. If you feel that your legs are getting tangled up and you can't keep moving, then you are in a tight spot but not helpless. You need to focus your energy on staying up. Don't let the defender pull you down. Then you should work on pulling your legs out from his grasp.
4. When trying to just avoid a defender, do not juke around too much! It will only slow your speed and make you more vulnerable to get tackled. You should juke with your upper body but keep your legs moving.
5. If you are breaking down the sideline and you see a defender coming from the side, keep running but be ready to make the first move. When you see him get close enough but not too close, make a small juke with your shoulders to try and get him to slow down and wait for you. Then bolt into the open field right as this pause happens; usually he will be caught off guard.
6. Stay moving. If you can't break the tackle and you are locked up, do your best to stay moving and stay upright.

## Tips

- As a wide receiver, it is often best to just take the hit (after catching the ball). Just anticipate the hit and when you feel the slightest nudge, move. Do anything, run faster, stop completely (only if the tackler is to the side or in front of you. Never stop if he doesn't have you and is behind you. Keep fighting.

## Warnings

- You can injure yourself by breaking tackles, so be careful. If you bend or fight too much and get hit, you can have broken bones. Know your limit.
- Stopping completely is risky (not injury-wise, but game wise. It might get your coach mad, and if the defender isn't fooled, you'll get hit hard.

# How to Catch a Football the Right Way

Catching a football the right way is something few people can do. Master it and you'll be catching balls like the pros instead of looking like a fool in either recreational or competitive situations.

## Steps

1. Keep your eyes on the ball **at all times**. Everytime you take your eyes off the ball you increase your chances of dropping it. If you aren't focused on the ball when it hits you in the hands, catching it becomes pure luck.
2. As the ball approaches extend your arms so your hands meet it at the highest possible point. Do *not* run with your arms extended you will look like an idiot. Extend your arms right before the ball reaches you.
3. Make a triangle with both hands, palms facing away from your body. Thumbs pointing at each other, all other fingers pointing up. You want the tip of the ball heading for the open space inbetween your two hands. If the ball is below the waist, palms still face out, but put your pinkies together.
4. Catch the ball, letting it get about halfway between your hands before clamping down on it with all ten fingers. Keeping your eyes on it the whole time. (If the pass is below the waitst let the ball slide through the inside of your palms about halfway and then clamp down on it)
5. Proceed to tuck the ball away, safe from any defenders.
6. Now that the ball is caught, run with it (football game), throw it back (playing catch), or whatever the game your playing requires you to do.

## Tips

- **Keep your eyes on the ball at all times**. Some people think they are keeping their eyes on the ball and they really aren't. The more focused you are on the ball, the better job you will do of catching it with your hands.
- Ignore the rest of the world and focus on the ball. There is no sky, no ground, nobody else even exists. The only thing is that ball and your hands.
- Watch the rotation of the ball. The rotation velocity affects your ability to catch it. The faster the spiral the harder you will have to grip it. If the pass is a wounded duck (the rotation is all over the place because it is an ugly pass) then you will have to adjust your hands to get a could grip when you catch it.
- DO NOT catch with your body. That is wrong. It can hurt, it increases your chances of fumbling it, and if your wearing pads you will drop it a lot. I don't care what you saw Joe Pro doing on TV, because Joe Pro runs a 4.2 40 yard dash and people are more concerned with what he does after he catches the ball. Even so, his coach probably still tells him to catch with his hands.

- Practice, practice, practice. You can't master anything by reading it in a book (or online). You need to get out there and practice.

## Warnings

- If you're no good at catching a football, start off with a Nerf football. That way if you whiff at catching the ball and it pegs you in the head, it doesn't hurt nearly as bad.

# How to Do a Front Ball Kick

A front ball kick is a front kick that strikes with the ball of your foot. It is pretty strong.

## Steps

1. Bend your knees just a little.
2. Bring your knee up. (Flamingo stance.)
3. Push out your leg into your target hitting with the ball of your foot.
4. Now do number 2 & 3 all in a combination quickly.

## Tips

- Practice steps 2 & 3 slowly.

# How to Juke in Football

Juking out opponents in football is easy if you use the correct technique.

## Steps

1. Face foreward and evaluate the field.
2. Look both ways and decide who will be close to you first.
3. Check in front of you and get ready to use the foot that is nearest to the opponent to pivot off of.
4. Use that foot to push off of and change your direction to a lateral step making sure you maintain your balance.
5. Plant your feet and start to move in a forward motion.
6. Evaluate the field again to see more oncoming opponents.

## Tips

- Make sure to stay low and keep you balance throughout the movement.
- Look in the opposite direction you are cutting, if you look in the direction your cutting instead of the direction your juking you are telling the defender which way your cutting instead of faking him or her out.
- Only make one, or maybe two, juke steps. If you just keep dancing side to side, then the defender will easily tackle you.
- Sometimes it's best not to juke (especially in the backfield), it's often better to pick a hole and go.

## Warnings

- Start the moving soon enough with enough space in between you and the opponent so that you aren't tackled.

# How to Juke or Dodge a Defender in Football

Avoiding or "juking" a defender effectively is what allows a rusher to attain more yardage than if they were to try to run "through" the defense every time. It works best in the open field.

## Steps

1. Get the ball. Spot the defender who's about to tackle you.
2. Keep your head up so you can see the field - you need to know where you want to move before you go. The center of the field is usually the best side to run to as it gives you more space to run free. The sideline is the defense's 12th man. Because of this, it may be useful to juke towards the sideline, then quickly dart in the other direction.
3. Run directly at the defender before you make your move, do not run to the left or right of the defender if at all possible as you will have to cover more distance if you intend to cut back to the opposite side. Running directly at the defender will make your move less predictable too.
4. In general you will not have enough time to make more than one move as the defense will be coming at you from behind.
5. Experienced defenders are taught to watch your hips, not your head or torso. An inexperienced defender (or in the case of a simple pick up game) will watch

shoulders; use this to your advantage. Juke with your shoulders rotating in the opposite direction of where you intend to cut back.
6. As get to within 1-3 yards of the defender, lead him to pursue you in the direction opposite that which you intend to go. Do this by twitching your hips or wiggling your shoulders in that direction.
7. If it appears that the defender is committed to pursuing you in that direction, great! You're one step closer to leaving him in the dust, quickly plant the foot opposite the direction you want to go, shift your weight, rotate your hips, push off with both feet and explode in the new direction (you may need to make this first move completely lateral depending on how good your initial move was).
8. Use the arm closest to the defender to bat away his hands or even lay a nice stiff arm. If the defender is really close, you can also lower your shoulder and give the guy a really hard hit under the chin or in the chest. 75% of the time, the guy will let go. If done correctly, this can cuase plenty of damage.
9. Pull your feet forward and high; the last thing you want is to be "shoe string" tackled after dusting a defender

# Tips

- Never stop moving your feet - this will help you to make quicker moves
- Don't forget to protect the ball
- Speed and quickness are not the same thing - you need to practice quickness for juking and speed for open field running.
- Use mental imagery to see yourself moving quickly and effectively avoiding defenders - this is how professional athletes mentally train. You need to see it working in your head to make it work in reality
- Watch videos of "The Great One", Peter Warrick, a wide receiver and twice a consensus All-American for Florida State University. Warrick was one of the best fundamental juke artists college football has ever seen. In 1998 versus his arch rival the University of Florida, Warrick caught an errant tipped pass by linebacker Marquand Manuel, spun around, a great fake towards the sideline causing cornerback Bennie Alexander to committ in that direction. Warrick bounced to the center of the field, dusting Alexander. He then lept over the diving safety and the rest was history. Warrick's heroics changed the momentum of the game and Florida State won 23-12.

# Warnings

- Don't overuse this technique - you may find yourself in the backfield scrambling around people while not making forward progress. Sometimes it's best to put your shoulder down and head upfield. You need yardage!
- Be careful of the "spin move" - although effective, you could end up getting hit in the back or injure an ankle.

# How to Kick a Field Goal

This article will cover the basic of nailing a football through the uprights. A good kick can win the game for your team, therefore, it pays to perfect your kick. This can be difficult and takes much consistent practice, but this should help make it easy.

## Steps

1. Have the ball held with the laces pointed away from you. It should be leaning slightly towards you.
2. Take 3-5 steps backwards and the same amount of steps to the opposite side than your kicking foot(left if you are a rightie, and right if you are a leftie).
3. Run towards the ball.
4. Point your non-kicking foot in the direction you want the ball to go.
5. Kick the ball with your ankle locked at ninety degrees.Run up to the ball and place your non-kicking foot to the side of the ball and swing your kicking leg forward.Kick about one or two inches up the ball.
6. Follow through as much as your flexibility will allow.

## Tips

- Attempt to spin through the ball. This will give you more power.
- Approach the ball at a diagonal.
- If kicking off a tee, aim your kick at the bottom of the tee.
- If you do not have a holder, you can buy or make a plastic one.
- If the ball misses short, try kicking the ball harder or closer to the middle of the ball.
- Plant your non-kicking foot about 5-7 inches away from the ball.
- Kick with the inside of your foot or with your laces.
- Keep your head up and eyes down.
- Don't adjust your form for longer kicks
- Be consistent, kick in the same way for a 20 yd kick as you would for a 55 yd kick(except for the amount of power that you actually put into the kick)

## Warnings

- Don't follow through too much.
- When running at the ball, don't slip.
- Don't kick the ball with your toes.
- Don't compensate for the wind too much.
- DO NOT KICK WITH YOUR TOES. This can lead to injury and an inaccurate kick.

## Things You'll Need

- holder/tee
- football
- Open area
- Goalposts

# How to Kick a Good Drop Punt in Football

A drop punt is a kick always used in football. If you are unable to complete one properly then you will never be able to make it in the big time.

## Steps

1. Hold the ball so it is pointing from toes to your chin.
2. Put your middle fingers on the side seams of the ball.
3. Hold your other finger spread out evenly to the sides.
4. Slowly start to drop the ball onto your foot whilst leaning forward. As you drop the ball, remove your weak hand and guide the ball onto your foot using your stronger hand. Try to keep the ball vertical as it falls to your foot.
5. Kick the ball, pointig your toe at your target and make sure you follow through.

## Tips

- Remember to lean back with out falling over to create spin this will add distance and to make it harder to catch, follow through the ball and don't try to kick it out of the park.
- Try to aim for the core of the ball.
- Watch the ball at all times.

## Warnings

- Remember to stretch before doing lots of exercise and running.
- Be careful not to kick the ball as hard as you can, bringing your leg through too hard and quickly and tearing a muscle.

## Things You'll Need

- A football.
- Football boots or trainers

# How to Make a Football Spiral

Do you want to watch your football soar through the air with a glorious spin? A little technique with your hands and fingers goes a long way. With some practice, you'll be rifling the ball around your yard in no time!

## Steps

1. Grip the football on the under belly with you index finger on the ball seam making a sort of "L" shape with your index finger and thunb
2. # Hold the ball up near your right ear, if you're right-handed, or left ear if you're left-handed. You will have a much quicker release which will give a defender less time to react to your throw, hence increasing your completion percentage.
3. Keep your eyes on the target, your shoulders close to parallel to the intended target and your pivot/plant foot pointing nearly at the target you intend to throw to. (Your pivot foot is the opposite side of your throwing arm.)

4. Make the throwing motion circular, albeit a half circle from top to finish; think of centrifugal effect, with the release being at the top of the arc. The longer the radius of the circle, the faster you will be able to throw the ball (i.e. the further you extend your arm from your shoulder, the more velocity you can achieve with less arm speed).
5. Shift your weight nearly evenly at release. About 60% of your weight will be on your front foot at release. As you get more comfortable slinging it around, you will be able to step into your throws. A good QB will need to step into his throw to complete a 20 yd sideline pass.
6. Use the rotation of your shoulders timed well with the throwing motion of your arm to generate the torque needed to achieve maximum velocity on your throws.
7. Find your release point. Footballs tend to sail through the air quite well when a decent amount of spin has been imparted on it. A certain release point will generally be good enough to cover 5-15 yds, a slightly higher release will rocket the ball 15-25 yds and so on and so forth.

    - A three quarter release is generally a very easy way to throw.
    - Remember to follow through with your arm fully to the hip opposite of your throwing arm. If released properly the ball will drill through the air.
    - To throw a deep ball, just change the launch angle. A perfectly thrown deep ball will nose dive beautifully at its peak.
8. Practice throwing with 50% or less effort - the release is very important. Next, with very low effort, get the timing of your shoulder rotation in tune with your arm's throwing motion to generate maximum velocity without maximum effort.

# Tips

- A proper throw will feel like it's only utilizing the thumb, index and middle finger. A good release will "roll" off of your index and middle finger. To impart more spin, you may snap your wrist through as you follow through to the hip. The other three fingers on your hand stabilize the ball as it's being flung. They should not be used to impart spin on the ball.
- The release and follow through are very important, more so than the throwing motion. Release and follow through are the difference between throwing a wobbly "duck" and rifling a throw that nails your receiver between the numbers.
- Your fingertips should be the last part of your hand to touch the ball. This helps ensure good spin.
- An excellent exercise is to throw the football up and down. You can really grasp the concept of the release by using this exercise and as you learn to throw higher and higher, your catching will become better, too.
- Watch videos of Florida State quarterback Chris Weinke, consensus All-American and 2000 Heisman trophy winner. Weinke's throwing motion is close to being perfect. His release is a little slow, but near perfect. He throws one of the best high arcing and accurate deep balls in the NFL.

- When following through, make sure your thumb points to the ground just after you release the ball. This way, you get more spin and accuracy into your throw.

## Warnings

- Do not hurl the ball with the palm of your hand. It will have no spin, and instead of spiraling, it will just flop end-over-end in the air.

# How to Quarterback a Football Team

Quarterback is the greatest position to play. You handle the ball every play, and every play begins with you.

## Steps

1. Quarterbacks have to be smart on and off the field.
2. A quarterback has to remember every single play in the playbook and do it correctly.
3. Quarterbacks have to be smart thinkers. It also helps to be a fast runner, but this is not necessary, considering most of the game you will be getting the ball to others to handle.
4. Quarterbacks are the leaders on the field. They need to control the game. There is no room for error in a football game so quarterbacks need to keep their heads up.
5. They also need a strong, accurate arm and they need to be able to see the whole field.
6. Quarterbacks have to be able to run with the ball, throw the ball.
7. Quarterbacks must read coverages, and see mismatches.
8. Quarterbacks must make their throws before the receiver makes his break/cut so that the ball gets to the receiver as soon as he gets open.
9. Quarterbacks must help create space for his receivers by looking off the safety and not telegraphing who he is throwing to.
10. Quarterbacks must follow progressions and have bailout options in case of a blitz or broken protection. If you're not as fast as Michael Vick, do not try to dance around in the pocket. Hit the open receiver or get rid of the ball.

## Tips

- Work in the offseason. Get a lot of reps in the offseason so your better then ever the next season. RUN RUN RUN RUN RUN build your endurance and you can excell at any level. A great man once said "I think good physical conditioning is essential to any occupation. A man who is physically fit performs better at any

job. Fatigue makes cowards of us all." That great mans name is Vincent Lombardi. This great man also said "Leaders are made, they are not born. They are made by hard effort , which is the price which all of us must pay to achieve any goal that is worth-while."

## Warnings

- Football is a very rough sport. Thats what makes it great. If you need any type of extra padding like say a brace, wear it because if you get down in the trenches and a guy hits that part of your body its gonna hurt for a long time.

# How to Read the Defense As a Quarterback

In order to become an effective quarterback, you have to be able to read the defense like a book. Want to improve your skills? Read on.

## Steps

1. Look at the safeties; if they are deep, run the ball. If they are not, play-act to look like you are going to run the ball.
2. Check if it's a zone defense. If it is, the safeties will be playing close to the middle.
3. Check for holes; this is the most important thing to look for. If a receiver is not going to be in a hole, change the route.
4. Look for a blitz. The hungrier the defensive players look, the more likely they are going to blitz.
5. Learn the different coverages defenses employ. You need to be able to recognize cover-1, 2, 3, and 4.
6. Know the weak areas, the hard to cover spots, ie., zones of the field that are easiest to exploit for each specific type of coverage.
7. Distinguish which defenders are cheating or overcompensating, e.g., a safety in cover-2 is creeping up and jumping the 15-yd quick post. A QB must recognize this and make the safety pay by pump-faking and then airing the ball out for the double-move fly route.
8. Look at how loose or tight the corners are playing. If they are keeping a cushion, you need to make the quick throw such as a WR screen, quick out, curl, stop, or slant. If they are playing tight bump-and-run, you need to look to the fly, corner, fade, or deep post, or deep out.

9. Recognize mismatches. If you are lucky enough to have a standout wide receiver, there will be times when the defense gets locked into a mismatch. You must instantly recognize it, seeing when a poor defender is on that receiver, and exploit it by going to that receiver. Get the ball in his hands and let him go to work.
10. Pay attention to game film. If you're going to be able to read a defense like a book, you first need to understand the language the book is written in. Watch the film carefully and pay attention to the body language of each and every defender before each and every play. Look for patterns, and when you actually get on the field, you'll know exactly what's coming.
11. Do most of your work before the snap. You don't have very much time to read the defense after the snap. After the snap, glance to make sure the defense wasn't disguising the coverage, and then make the throw that you know will be open.
12. Read during the pre-snap read as much as possible. If the safties are equally sided by each other while the corners are tightly on there receivers, the safties are going to be in cover two while the corners play will playman. If a safety lines up on the tight end. all the defense bacs are playing man.

## Tips

- The more games you play,the better you get at reading the defenses. Go out and play.

# How to Tackle in Football

Have you ever played football and the ball carrier zooms right by you? Well learn how to tackle the right way either to bring down, to force a fumble, or to deliver a hard hit.

## Steps

1. **Bring the ball carrier (BC) down**
    - You put both hands out to try to slow down the BC.
    - Then wrap your hands around the BC's waist and with your own weight you bring him down.
2. **Force a fumble-step**
    - You go straight ahead to the BC and aim straight to ball and try to "strip" it by pulling the ball as hard as you can (the stronger you are the better).
3. **Deliver a hard hit**
    - You run straight ahead to the BC and with all your power hit him!

## Tips

- NOTE that if you are going to do a hard hit you must be strong.
- If you are going to strip the ball you need to know how to tackle .

## Warnings

- WARNING if you think you are not strong enough to deliver a hard hit then don't try, or at least work out a little.
- Also to strip the ball it could be easy to hurt a finger so it would be best to practice a little.

# How to Take a Snap in Football

If you want to be a great quarterback,you need too learn to take the snap.

## Steps

1. Put your thumbs together and to the side.
2. Put the top hand on the curve line of the center's bottom.
3. If the ball hits your throwing hand,than you got it right.

## In the Shotgun

1. Have the tips of your thumbs together.
2. Keep your eyes on the blitz.
3. On the snap, get the ball but keeping that hand position.

## Tips

- Always keep your eyes on the defense, even in the shotgun.
- If the center isn't getting the ball to you correctly (e.g. if they are hitting your bottom hand and not getting the ball up to your top hand), tell them! If they don't know that they're doing something wrong, it's not going to improve, and you will fumble.
- Also make sure that your hands are far in, otherwise the ball will bounce off your fingertips and you will fumble the ball.

## Warnings

- If the ball hits your other hand,your snap hands are wrong and you might fumble the football.

# How to Throw a Football

Football is arguably America's favorite sport. So, if you live in the US it's good to know how to throw a football.

# Steps

1. Hold the football in both hands.
2. Start by putting your finger of the dominant hand along the laces and your thumb towards the bottom.
3. Make sure to position your dominant hand towards the back of the ball.
4. Simply place you other hand on the other side of the football (you don't need to line it up with the laces or even have it there at all).
5. Drop back a few steps.
6. Before you throw (if there is time and space) move in the direction your throwing.
7. Now stop by putting the foot opposite your throwing (dominant) hand firmly in front of you.
8. Rear your arm with your hand at the same level with your head (release your other hand by now).
9. Thrust your arm foward with your body. Let the ball roll off your hand, with the tip of your finger being the last thing touching the ball.

# Tips

- If you are throwing a short pass, moving the direction of the throw may not be necessary.
- Thrusting your hand upwards when throwing will make the ball go higher, resulting in a possibly longer softer ball.
- Having your hand level will result in a "line drive" pass that is faster and harder but may not cover as much ground.
- Your pinky (of your throwing hand) should be on the 4th lace (it doesn't matter which way; the 4th is the middle). Iff done correctly, you will throw a perfect spiral every time! You will eventually get used to the feel and throw it naturally.

# Warnings

- ALWAYS TRY TO AVOID THROWING:
    - with only one foot on the ground (after you throw your back foot may come off the ground that is fine)
    - while leaning back
    - across your body (i.e. throwing to the left when facing right)
    - turning and throwing (i.e. facing one way and making a 180 degree turn then throwing; making a smaller turn is okay, it may actually help the throw)

## Things You'll Need

- football
- decent space

# How to Win at Football

Tired of always losing football matches and getting hurt? Read this and you will probably win more often.

## Steps

1. 

   Do a few stretches, you don't want to twist your ankle or worse!

2. You should always make a plan, like tell your team what you are going to do, so when you want to pass they will know.
3. Ok here is the part where people sometimes have trouble, it's the tackling. You don't always need to tackle, spear them. As you can see in the picture, that is a wrestling move but just be careful you dont hurt the person and you dont hurt your own face on the ground.
4. When you are passing to make a goal, there always needs to be someone in front of (at least 3 feet away) the goal post.
5. When you are trying to throw the ball, first look around quickly, then as fast and as hard as you can throw the ball through the goal post.

## Tips

- WHEN PEOPLE ARE RUNNING AFTER YOU, DON'T JUST RUN TO THE GOAL POST AND THROW THE BALL.

## Warnings

- 

  Be ABSOLUTELY careful when you are doing the 'SPEAR'.

## sThings You'll Need

- A football.
- Big space and a football goal post.

# Cricket

How to Bowl a Flipper
Like the googly, the flipper is yet another weapon in the leg spinner's armoury.

Rather than turn away from the bat like a normal leg spinner or towards the batsman like a googly, the flipper skids on low and fast after pitching.

You could describe it as a back spinner - and like the "wrong'un", it takes plenty of time to perfect.

The ball is "squeezed" between the thumb and fingers in a way so it spins backwards and skids on low and fast with under-spin after hitting the pitch.

## Steps

1. Hold the ball like a normal leg break with the top joints of the index and middle fingers are across the seam.
2. Unlike the leg break and googly, it's the thumb that does most of the work. Imagine you're clicking your fingers when you release the ball.
3. The ball should be rotating in a clockwise direction with the seam facing the batsman.

## Tips

- The grip - The fingers are brought further forward on the ball
- and the thumb plays a part. Shane says his grip is not too
- tight as this can stop the ball fizzing out of his hand.
- The delivery - The trick is to not bowl it too fast.
- When he stays relaxed and squeezes the ball out through
- fingers and thumb (an instant after the centre picture),
- the underspin makes the ball slice through the air more quickly.

**How to Bowl a Googly**
The leg spinner's prize weapon - bowled properly, a googly is almost undetectable. A googly, or "wrong'un", is a delivery which looks like a normal leg spinner but actually turns towards the batsmen, like an off break, rather than away from the bat. Unlike a normal leg break, a googly is delivered out of the back of the hand, with the wrist 180 degrees to the ground.

## Steps

1. Hold the ball as if you're about to bowl a normal leg break.The top joints of the index and middle fingers should be across the seam, with the ball resting between a bent third finger and the thumb.
2. Position your hand accurately. At the point of release, the palm of your hand should be open upwards, towards the sky, with the back of your hand facing the batsman. Your wrist should be 180 degrees to the ground, while the seam of the ball should point towards fine leg. Again, it should be your third finger which does most of the work, turning the ball anti-clockwise on release. You'll probably find it goes horribly wrong the first few times you give the googly a try, but don't give up. As the old saying goes, practice makes perfect. Use a tennis ball to help improve the flexibility of your wrist.

## Tips

- Keep that wrist supple and make sure you finish the bowling arm towards your back thigh like you would with an in-swinger.
- Most effective if pitched on driving length outside the off stump. Getting the righthander to drive against the spin.

# How to Improve Footwork in Cricket

Cricket is mainly about scoring runs. Runs are scored by batsmen. Batting requires coordiantion between eyes, hand, legs and the rest of the body. This How-To manual will hopefully help you to improve that coordination, especially the eye, hand and leg combination.

## Steps

1. EXERCISE A
2. Stand erect with hands on hips
3. Jump, spread legs wide apart landing with the feet apart.
4. Jump again and return to start position, i.e body erect and feet together.
5. Jump again with right leg forwrd and left leg backward landing with one foot in front and the other behind, as though you took a step forward.
6. Jump and return to the errect standing position.
7. Repeat 2-5 ensuring at Step4 you alternate left and right legs movements.
8. EXERCISE B

## Tips

- Increase speed as you get fitter and are more comfortable with the exercises.

## Warnings

- Do not jump too high. Height is just enough to move the feet off the ground.

# How to Play Cricket


Cricket game underway

Cricket is a teamsport played between two teams of 11 players. Each team has its own captain, multiple batsmen or batswomen, multiple bowlers and other players acting as fielders. It is a bat-and-ball game played on a roughly elliptical grass field, in the centre of which is a flat strip, called a pitch.

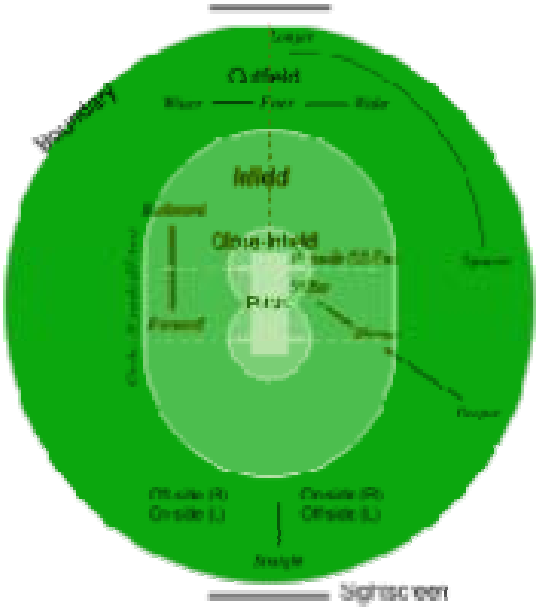
## Steps

1. **Choose the batsman/batswoman and bowler.** A team consists of eleven players. Depending on his or her skills, a player may be selected as batsman/batswoman or bowler.
2. **Choose the wicket keeper.** Teams nearly always include a specialist wicket-keeper because of the importance of this fielding position.

3. **Choose the umpire.** Two on-field umpires preside over a match. One umpire will stand behind the wicket at the end from which the ball is bowled, and adjudicate on most decisions.
4. **Choose your match type.** There are 2 types of matches:
    - ODI (One-Day International); and
    - Test Match

    The most common one is ODI, because in this type of match, each team has to play 50 overs (6 Balls per over) and it is played for one-day only. Read more about test matches by clicking here.

5. **Choose which team plays what.** Selecting which team will play what (batting/bowling-fielding), is decided by making a **coin toss** between the captains of the two teams. The captain who wins decides which play to take whether batting or bowling-fielding.
6. Start playing!




Cricket field positions

# Tips

- Try to learn some of the main rules, which will prevent you from being "out".
- Read all the rules first throughout the link provided in "External Links", and then play, because this article hasn't explained about "runs" etc; to do this would make the article too long. This article is just an explanation of the procedure before starting playing the game.

- Watch famous bollywood movie Lagaan -it explains very simple and fun way of learning cricket.

## Warnings

- Do not cheat in this game, for example, you have been selected as the umpire, so don't be showing favor for the opposing team only. Play fair and fair play!

## Things You'll Need

- A stadium or a large ground; the local oval is fine
- A wicket
- Bats
- Balls
- Umpires who know all 42 laws of cricket
- Protection equipment known as cricket kit, which contains helmet, elbow guard, leg pad, gloves, abdomen guard.

# How to Play a Backward Defence in Cricket

A quick guide telling you how to play a very handy shot in cricket; the backward defence.

## Steps

1. Step back onto the line of your off stump.
2. Get a nice high backlift.
3. Swing the bat through the ball.
4. Follow through.
5. Keep the bat on straight facing the bowler.

## Tips

- Always remember to step back at an angle so you are in line with your off stump

## Warnings

- Always keep your eye on the ball

# How to Reverse Swing a Cricket Ball

Now you can master the art perfected by Imran Khan, mate.

## Steps

1. Take a 20-30 over-old ball whose one side is still shining. Such a ball is usually heavier on the side of shine because of sweat put on it to shine, whereas the other side has gone through wear and tear without any repairs. This weight difference is what bowlers take advantage of.
2. Hold the ball along the seam, with shining side towards leg side and rough side towards the slips.
3. Flex your wrist along with the cricket ball such that the shining side is about 30 degrees downwards.
4. Bowl with your hands angled. The angle between your head and bowling hand at shoulder should be about 50-60 degrees. Bowl with your hand as much away from your head as possible.
5. Make sure that in the follow-through, your bowling hand goes between your body and the stumps (on either side of your body.)

## Tips

- Shine the ball very much and make the other-rough side as rough as possible. To test if the ball is ready for a reverse swing, just throw the ball with straight seam to a fielder and if the ball swings towards the shining surface, then it's ready to dance the batsman out.
- You must pitch the ball up, reverse swinging yorkers can be devastating - as Waqar Younis proved at his peak. Few bowlers can reverse a ball away from the bat - hence the success of Simon Jones and Andrew Flintoff against the Australians.
- Practise reversing an old, prepared ball in the nets. It's not going to happen by magic in the middle if you haven't practised it thoroughly.

## Warnings

- Wrist position and follow-through are important.
- Using a blade or metal to quicken the process of creating a rougher surface is always and in every circumstance illegal and not in the spirit of the game. If you get caught 'ball tampering' by the umpires you'll get banned from the game.

# How to Time a Cricket Stroke

Batting is a matter of 'timing' rather than brute force. Timing a ball isn't a mystery, but a skill anyone can improve - even if your name isn't David Gower.

# Steps

1. Point your elbow at the bowler as he runs into bowl. This encourages you to play straight. You should aim to 'rock the baby' with your elbows as you drive the ball, rather than slogging across the line.
2. Pick your bat up high as the bowler prepares to bowl. A high, straight back lift allows you to generate bat speed as you hit the ball.
3. Begin the downswing of the bat much slower than you think you should. This stops you playing at the ball too early, makes you watch the ball longer and means that you're accelerating the bat through the ball as you hit it. Sloggers swing hard and early, meaning they hit the ball too early and too slowly, spooning catches in the air.
4. Lean into the ball as you hit it, so the whole weight of your body is transferred into the ball. Bend your front knee as you play the ball and point your toe in the direction that you want to hit it. Pointing your toe at the bowler, as 'golden age' batsmen did is still a good idea.
5. As the ball hits the bat, and not before, uncoil your wrists to add punch to the ball. This does not mean hitting everything to leg, you can throw your wrists to the off side as if you're playing a hockey shot.
6. When cutting or hooking the ball, make sure your arms are fully extended. A cramped shot creates a catch.
7. Hit every ball along the ground, except an attempted hook or straight drive for six.

# Tips

- When assessing the field before taking strike always look for the gaps, never at the fielders. You'll subconsciously hit the ball into the gaps as a result.
- Use your feet against spinners in defence as well as attack. You're much more likely to be stumped by inches than by yards.
- Remember that no matter how tired you are, the bowlers and fielders are feeling worse. If you feel your concentration slipping, call for a drink, remark your guard and survive to the end of the over.
- Have a word which you say to yourself as the bowler is about to deliver to turn your concentration on. 'You're not going to get me out' or 'now' or 'be first'. Turn your concentration off between balls and when not on strike. No-one can concentrate for two hours non stop.

# Warnings

- Don't premeditate a shot, you can premeditate attack or defence as a principle, but never the actual shot to be played.

- Don't be riled by 'sledging' - the bowler always has to return to his mark so silence on your part always wins.
- Don't try to change your technique in the middle of an innings. Always work on something different or constructive in the nets - instead of trying to slog everything - but stick to what you know in a game. If you're never reverse swept before then a cup match isn't the time to first have a go.
- If you're going to flash then, of course, flash hard!

# Volleyball

## How to Backset a Ball

If you're a setter in volleyball, this is a necessity. Even if you don't play volleyball, this is a lot of fun to do when you're bored, or with a group of friends.

### Steps

1. Get in the proper volleyball position. (Really low, like you're sitting on a chair, except a little more bent forward. Hands apart, knees bent.)
2. Have a friend (or do it yourself) toss you the ball.
3. When you are ready to set the ball, do a normal set leaning backwards. Your hands should be in the same place, but your back needs to be arched backwards. But make sure you don't arch too far....you mainly obtain a backset with your hands, not the arch in your back. Your arms are above your head also pushing back.
4. After you have this down work on putting the ball in a certain spot. Wen you are on the court you need to always know where your hitter is, so practice setting towards your "hitter"

### Tips

- Dont do this until you have your normal set down pat.

### Warnings

- You must stretch perform performing this move. If you do this without streching first, you risk spraining your wrist.

## How to Bump a Volleyball


Getting ready for the bump

The bump is a simple, but useful skill in volleyball. The bump is used to hit a ball that is below the head. There will be many times when the bump is a necessary shot in a volleyball game and it is definitely worth your while to learn. If the bump manages to elude you, read more to master this useful skill.

## Steps

1. You should be in the ready position, prepared for the ball. To do this you should: Place your feet about shoulder-width apart. Then bend your knees, but keep them in line with your toes. Make sure to keep your arms in front of you. Finally, be ready to move in any direction and watch the ball.
2. Hold your arms out straight in front of you, parallel to the ground. Join your hands and lock your elbows, thus making a flat platform for the ball with your forearms.
3. When the ball comes your way, move to get under it. Bend your knees, remembering to keep your arms level. When the ball is right above your forearms, straighten your legs. This should cause the ball to go straight up, ready for one of your teammates to volley or smash it to the opposing team.

## Tips

- Remember, keep your arms straight and level. If you tilt your arms a little, the ball will go in the direction perpendicular to the angle of your arms. This can be done purposefully in order to hit the ball towards a teammate. Make sure that you have the ability to hit a straight bump so you can better control where the ball goes when you have to hit it in a game.
- Practice is definitely necessary when learning the bump. A good way to practice is to bump a volleyball against a wall as many times as you can in a row.
- Try not to "swing" your arms when passing a ball. This could cause a "wild" pass and is not easy to get to. Instead, try to use your legs and face where you want the ball to go.

## Warnings

- Be sure not to cross your thumbs. This could lead to injury if the ball accidently hits your hands.
- Do NOT hit the ball with your hands. Many people say it hurts to play volleyball but it is usually because they are hitting the ball with their hands. This also will cause the ball to be "shanked" and may even go all over the place.

# How to Do an Underhand Serve

Get that volleyball over the net!

## Steps

1. Put the ball in your right hand (if you're left-handed, vice versa).
2. Pull back the hand that is not holding the ball.
3. Swing hard forward.
4. Get ready for the return.
5. change the angle of your arm to change the trajectory of the ball

## Tips

- Make sure you hit it hard enouph to go over the net.

## Warnings

- Don't use a ball that is too hard for you. You could end up with some bruising.

# How to Make the Sports Team

Wanna try out for volleyball or basketball? Read here to learn how to make the team.

## Steps

1. Find a sport that interests you.
2. Learn the rules and regulations of that sport.
3. Practice the sport.
4. Exercise and train to build stamina.
5. Get the supplies you need.
6. Have a friend practice with you.
7. On the day of the tryouts, be on time.
8. Wear the appropriate attire.
9. Be polite and patient.
10. Be prepared.
11. If your sport is a team sport, be a team player. Don't act like a showoff.
12. help other people out, cheer and pump up the other players (the coach will want people that support each other)
13. try again and again
14. Hope that you make the team.

## Tips

- Sign up for the tryouts early. Don't sign up at the last minute.
- Don't talk with others while the coach is talking. Pay attention.
- Wear deodorant and bring water.
- Shake the coach's hand(s) and thank them.
- if you dont make the team try it again next year
- Going to a camp could help...A LOT!!!
- Coaches look for people who are "coachable"

## Warnings

- always streach, so you wont be sore at the end

## Things You'll Need

- A good attitude
- Coachability
- Some background of the game

# How to Perform an Underhand Volleyball Serve

This tutorial will teach you how to properly perform an underhand serve in volleyball.

## Steps

1. If you are right-handed, put your left leg forward and slightly bend your knee.
2. Place the the palm of your left hand under the volleyball and hold it out in front of you.
3. Make a fist with your right hand.
4. Let your right fisted hand drop (to where it would normally be) and then bring it back beyond your hips a little bit.
5. Swing your fist forward, underhanded. The trick is to hit the ball with the inside of your wrist and not your hand. Step into it with your left foot, but don't let your foot go over the line.
6. Once you make contact with the ball, continue your swing (follow through) and bring your right hand over your left shoulder.

## Tips

- *Slow down*. It's common for people to miss serves because they get too excited and rush into it without really focusing on their form.
- If you follow all of these steps but the ball always falls short, it is probably because you have not yet built up enough strength to get it over the net. Use some momentum--put your body into it.
- Coming up with a "routine" before serving, such as bouncing the ball a few times, or turning it so that the logo faces forward, will get you used to performing a consistent serve. This works because you are always doing the same thing before you serve, which sets you up for always being steady and consistent in the serve. Many people suddenly become excellent servers just by using this tip.
- Don't forget to hit the ball with your wrist!
- Practice makes perfect.
- Always follow through.
- Always face the direction that you want the ball to travel.
- Never throw the ball; it should always be in your left hand until you hit it.
- If you accidentally step over the line or come very close(a foot fault), remember on your next serve to step back about 6 inches

## Warnings

- This might hurt your wrist a little bit.
- Experiment hitting the ball harder and softer to get better at the serve

# How to Play Scoreball

scoreball is a cross between soccer and volleyball. If the ball comes at you or above, you can knock it down.

## Steps

1. No dribbling. You may not bounce the ball like a basketball or it will be charged as a turnover.
2. No carry. You can't carry the ball along with you under any circumstance.
3. No complaining. The refs dont feel like hear you run your mouth.
4. No picking up the ball. You can not pick up the ball just because

## Warnings

- This is a very physical game.

## Things You'll Need

- A small room, tables, 7 on each team and a scoreball.

# How to Play Volleyball

Volleyball is a great indoor or outdoor sport. This article covers the outdoor variety, since you need less people, and can play in almost any park, or on any beach.

## Steps

1. Get some equipment. The minimum you need is a volleyball, a net. Any sporting goods store should have this stuff. Lots of nets come with lines, or you can use shoes or other objects to indicate the corners of the court.

2. Find a friend or three. You can start learning the basics of volleyball one other person by playing "pepper", that is, just practicing the basic skills by hitting the ball back and forth. If you have a foursome, you can play some games.
3. Warm up. Volleyball can be really hard specifically on the ankles, knees, and shoulders. Make sure you limber up those joints and get the blood flowing a bit before you play.
4. Practice passing. Passing is the basic skill of volleyball. It's also the most important. Make a "platform" by clasping your hands in front of you, with your thumbs together. Don't interlace your fingers. You can either make a fist with one hand and wrap the other around it, or bend one thumb down to its palm, and press the heel of that hand into the palm of the other. Either way, make sure your thumbs are together and your elbows are straight. Keep your knees bent, and let the ball contact your forearms about a third of the way between your wrists and elbows. Try not to move your arms too much- let your legs do the work. Practice accuracy and height control.
5. Practice setting. Look up, and make a diamond with your index fingers and thumbs just above the bridge of your nose. Now move your hands apart slightly. Throw or pass the ball right above your head, and position your body so the ball would hit you right on the nose if your hands weren't there. Now cushion the ball with your thumb, index, and middle fingers in this diamond pattern on the way down. Let your knees bend too as the ball comes down. Don't let the ball contact your palms at all, just the tips of your fingers. You typically want the apex of your set to be 1-2 feet away from the net, and about 4 feet above it. Try to make the ball have little or no spin once it leaves your hands. Have your partner pass you the ball, and you set it back to him/her. If alone, you can pass the ball to yourself, then set it. Try to stay in one place.
6. Practice hitting. First, just face your partner, and have him/her set or pass the ball to you so it's nice and high. When the ball leaves their hands, point to it with your weak hand, and pull your hitting hand back like you're pulling a bow and arrow- the back of your hand to your ear. When you're ready to hit it, extend your hand as far above you as you can, contacting the upper half of the ball with your open hand at the very top of your swing. The contact point is always in front of your head, not above it. Don't hit it hard at first, try to just control it to your partner's waiting platform. Hopefully he/she will just pop the ball back up, then you can set them for a hit. Once the timing is a little more natural, and you can contact the ball regularly the way you want, have your partner set you on the net, and practice hitting the ball over the net. Take one or two steps up to the net each time you hit (this helps you jump higher), and jump. Make sure to jump as high as you can, and contact the ball at the very top of your jump and swing. Snap your wrist so the ball will go down into the opposite court.
7. Practice serving. Stand on the end line, toss the ball, and with an open overhand swing, lob the ball into the opposite court. Try to serve purposefully to all areas of your opponents' court. When you're feeling ambitious, you can take a few steps back, toss the ball higher, and try a jump serve. The swing is almost identical to a spike.

8. Play a game! There are 2 different sets of rules. Traditional rules basicly mean that if you can only get a point if you served the ball, otherwise you just get the serve. These games usually go to 15. Rally scoring, which is used most often, is almost the oppostite. If you win the rally (volley), you get the point, no matter what. Most of the time you play to 25, but some younger teams may only play to 21. If the ball hits the ground in bounds, or one team can't get it to the other side in 3 touches, it's a point for the other team.

## Tips

- Passing is the most important skill. If you can control a hard spike or tough serve, and still pass the ball perfectly to your partner in the center of the court, the rest of the game becomes a lot easier.
- Anticipation is the key to volleyball. Try to get your body in position and still before the ball gets there. Your passes, sets and blocks will improve immediately and dramatically.
- To practice setting, you can set the ball to yourself off of a wall. It's a great shoulder workout, too.
- Blocking is really only worth it when one or more players on the other team can hit the ball hard and in the court fairly consistently. When they hit the ball so hard you don't have enough time to react, then it's time to start worrying about blocking.

## Warnings

- Make sure to clear the court and any close surrounding areas of debris before you play. Lots of times you are looking up at the ball, and not where you're going.
- True volleyball takes years of practice to get good. Don't expect to make even a middle school team if you've never been in a true game situation. Camps are good for learning technique, but they don't put as much pressure on you as if it was a game.

# How to Serve a Volleyball Overhand

The most reliable way to get your serves over.

## Steps

1. If you are a righty, place your right foot towards the net, slightly in front of your left foot. Your left heel should be in the middle of you right foot. If you are a lefty, do the opposite for all of these directions.
2. Hold the ball with both of your hands for maximum control. You should be holding it in front of your left foot.

3. Toss the ball in front of your hitting hand. The toss should be as far out as your arm can go and as high up as you arm can go. This may not be exact so practice finding the right height for you. After you have tossed, you should put your right arm up by your ear, as far back as it can go. Your elbow should be above your shoulder.
4. Swing your right hand forward, reaching as high as possible. Contact the ball with your whole hand, not a fist.
5. Once you have mastered the serve, trying flicking your wrist when you hit the ball for some spin.
6. Step on your left foot as soon as you hit the ball.
7. Get into postion again right away. You never know when the other team will return it.

## Tips

- Perfect your underhand serve first, so if you mess up, you are always confident with that!
- Make sure that the ball is filled with air or else it will fall flat on the ground.
- Practice makes perfect, so practice this a lot!
- Switch right/left depending on what hand is more comfortable for you.
- Toss ball ahead of you and snap your wrist upon contact to create topspin which makes the ball dive as it crosses the net.
- Practice serving in different ways like holding your arm higher or spotting the ball with your left hand-remember:serve the way that you feel the most comfortable doing.
- Don't punch the ball, swing at it.
- To get the ball to go straighter over the net throw the ball out a little more.
- Spend some time practicing only your throw cause it can mess up the whole serve.
- Using your momentum can help a lot especially if you have a small body
- Take a few steps or none, depending on how comfortable you feel.
- Make sure not to "slap" the ball.

## Warnings

- This may cause stress on your arm, so warm up before serving.
- It's all in the toss, so if you make a bad toss don't catch the ball just let it fall to the ground. The ref. will wave it off and you get to try again!

## Things You'll Need

- Volleyball, volleyball net

# How to Spike a Volleyball

Spiking is so not hard to do, but it will take some practice.

## Steps

1. Find somone to practice with.
2. Have your partner throw the ball to you and attempt to spike it just to see where you are. If you can't spike at all, then you and your partner will stand a foot apart from one another and keep on attempting to spike the ball until you make it over the net.
3. Move apart farther and farther until you are in the position from which you wish to spike.
4. Use an approach so you can get a better swing and jump.

## Tips

- If you're having problems hitting the ball down then practice jumping high enough so you can get on top of it.
- Practice correct form by hitting the ball on the floor and bouncing it off a wall
- For the ball to go down you must have topspin, in order to get topspin you must flick your wrist when hitting the ball. Practice hitting the ball against a wall and flicking your wrist forward.

## Warnings

- This takes awhile to learn so don't be discouraged if it doesn't work at first.
- Try to hit the ball with the palm of your hand instead of "slapping" it. It may hurt sometimes or it will make a really nasty sound. If you hit it correctly, there should be a nice "BAM!" sound.

## Things You'll Need

- ball
- net
- partner

# Basketball

## How to Be a Great Basketball Coach

Tips on how become a basketball coach.

### Steps

1. First, you need to figure out what kind of coach you want to become: a middle school coach, a high school coach, a college coach, or a pro coach. You can only become a professional coach after gaining some experience elsewhere, so this article will not deal with that aspect of your job search.
2. Next, call your local school district and find out what kind of training and certification you will need.
3. Go to school and get all your degree and/or certification.
4. While completing school, help out with local sports teams which your county, or a church may sponsor. This will give you experience and will strengthen your resume.
5. After you have graduated and you are ready to apply for a position,check the webpages of the all local school boards to find out what jobs are available and what the particulars of employment will be.
6. Knowing the right people will help you land that job, so be sure to make plenty of contacts along the way as you do your volunteering, etc.

## How to Become Great at Rebounding the Basketball

**Basketball Rebounding** is one of the most critical aspects of the game. Unfortunately, it is also one of the most overlooked when it comes to practice time.

Players often take rebounding for granted thinking that if the ball comes their way, they'll grab it. Or a more common mistake is that players often think rebounding is not their job or responsibility on the court. "I'm not a rebounder" or "That's my teammates job" are phrases that are often heard amongst players.

Well the truth is, basketball rebounding is every players' job and responsibility - regardless of their height or position. Every player must be a rebounder on the court.

To become great at **basketball rebounding**, players should possess the **eight qualities** listed below. The good news is that these qualities have nothing to do with a players' size. Instead, they have everything to do with their body position and balance, desire and aggressiveness.

# Steps

1. *Pursue the basketball.* Players should not stand still when the shot goes up - instead they should go aggressively after the ball. Great rebounders always think that the rebound belongs to them.
2. *Establish a good rebounding position.* When the shot is taken, players must quickly determine the following details: The shot location, the arc of the ball, and where the other players are positioned on the court. Players must then move to rebound the ball.
3. *Establish proper body balance.* Once a player is in a good rebounding position, they should spread their feet about shoulder width apart with their knees bent slightly. In this position, players can move side to side quickly and are also in a good jumping position. Another important point is for players to remember to stay on the balls of their feet, not flat-footed. Again, this helps them move and jump better.
4. *Box out your opponent.* Once a player has established a good position and is in good balance, they should then box out their opponent. This is done by getting between them and the basket as quickly as possible and then initiating contact with them using their back side. Players must be ready for contact - rebounding is the most physical aspect of the game.
5. *Possess desire and mental & physical toughness.* Great rebounders have the attitude that every missed shot is their rebound. They own the boards. This attitude helps them develop an unshakable desire and aggressiveness.
6. *Properly time your jump for the ball.* Once players establish good position and balance, and firmly box out their opponent - they now need to jump for the ball. A mis-timed jump can cost the player a rebound. By watching the shot and then reading where it will bounce, the player will be more capable of properly timing their jump.
7. *Protect the ball after the rebound.* There are several ways for players to do this: Hold the ball over their head; Chin the ball; or Hug the ball close to their body. How a player protects the ball will depend on how their coach teaches this aspect of the rebound. The main objective here is to protect the ball once it is rebounded. Don't let the opponent get it back.
8. *Develop soft hands and fingertip control.* Soft hands is a term that is used to describe a players' ability to handle the basketball regardless of how hard or soft it comes at them. They seem to be able to control everything. Fingertip control allows them to tip the rebound to themselves or to a teammate. These are critical rebounding qualities that give players a huge advantage on the boards.

# How to Become a Better Basketball Player

These basketball shooting tips are a great way for players, parents and coaches to learn and understand the proper mechanics and techniques needed to be a great shooter.

Every basketball player loves to shoot the ball! The most practiced skill in the game is shooting. Coaches spend a good deal of their practice time on shooting drills to improve their players' skill level. After all, if you can't shoot - you can't score!

Whether a player is shooting a jump shot, lay-up, or free throw - there are certain techniques they must use to be successful. The basketball shooting tips below will give players, parents and coaches a better understanding of what these techniques are!

## Steps

1. Remember BEEF (Balance, Eye, Elbow, Follow-Through) when shooting the basketball. Get into the habit of always using these proper shooting techniques - whether in practices or a game. If proper techniques are not used, bad habits are formed that are often difficult to correct. If players don't have a shooting technique - they need to develop one!
2. Be relaxed and concentrate on the basket. Focus on the part of the rim that is closest to you as you shoot the basketball. When shooting lay-ups and bank shots, focus on the part of the backboard where you will bank the ball.
3. Know when you have a good shot - and then take it. Find the right balance between shooting too often and not shooting enough. As you develop confidence in your shot, you will also develop the ability to know when you have a good shot to take.
4. Be in proper balance when shooting the basketball. Proper balance (front to back and side to side) is critical on all shots.
5. Follow through on every shot they take. Hold your follow through as this is one thing that will show you why you made or missed the shot.
6. Jump naturally. Avoid forcing your jump - it should be nice and easy. You should jump straight up and release the shot at the top of your jump. "Up, Hang, Shoot" is an easy way to remember this.
7. Make sure you have an arc on every shot you take. The height of the arc will vary from player to player. Some players shoot with a high arc, while others have more of a flat shot. As long as you are using proper shooting techniques and the shots are going in, then the arc is fine.
8. Be relaxed when shooting free throws. Concentrate on the basket, and have your knees bent slightly. Keep your routine simple. This helps your concentrate more

on their shot and not your routine. Avoid excessive and unnecessary movement. Only use the motion needed to take and make the shot.
9. Practice all of your shots. Learn to shoot from any location on the court, within your range. By doing this, you become more of an all-around shooter. Strive for the following shooting goals: 99+% lay-ups, 70+% free-throws, 50+% field goals, 33+% 3-pointers. These goals can be modified for younger players.

# How to Become a Better Offensive Basketball Player

**Basketball Offense: 10 Bad Habits To Avoid!**

In order for basketball players to be successful on the offensive end of the court they must develop good habits. At the same time, they should avoid or eliminate bad habits. As simple as this sounds, players have a tendency to continually repeat their bad habits on the basketball court.

Bad habits are developed the same way good habits are - through repetition. The key then, for coaches, players, and even parents, is to practice the good habits and eliminate the bad habits. This occurs during in-season and out-of-season practices and work-outs.

By avoiding the **ten bad habits** listed below, players and teams will be much more successful on the offensive end of the court.

## Steps

1. Focusing too much on the one-on-one aspect of offense, rather than the team aspect. Players that are more concerned with their individual game hurt the overall success of their team.
2. Standing around and watching the action, rather than being a part of the action. Players should not be spectators of the game. They must always be involved and moving, even when they don't have the basketball.
3. Looking to shoot before looking to pass. Players must always be aware of their teammates and the defensive players on the court. If a teammate is open and has a better scoring opportunity, then the pass must be made to them.
4. Looking for only one option on a set play. This makes the defenders' job much easier. Players must always look for various scoring options on their set plays. If the first option that opens up leads to a good scoring opportunity, then the pass should be made. Otherwise, the players should look for other options.

5. Telegraphing their pass to a teammate. These passes are easier for the defensive players to read and possibly steal. Players should use eye, head and ball fakes before passing the basketball.
6. Committing a cheap and foolish foul after making a mistake. Everyone makes mistakes in basketball. When it happens on the offensive end of the court, players should hustle back and play good, strong defense to make up for it. They should avoid committing fouls out of frustration.
7. Using fakes and moves that their teammates are not ready for or familiar with. Players must play within themselves on the court. New moves and fakes can be worked on during practice - not the game.
8. Being unaware of how much time is left on the game clock or shot clock. Players must always know how much time is left on the shot clock during each possession. They must also be aware of how much time remains at the end of each quarter, the half, and the game. This is every player’s responsibility, not just the point guard's and coach's.
9. Losing their concentration during an offensive possession. Players MUST ALWAYS stay focused and concentrate when their team has the basketball. They should know what their responsibility is at all times and also follow the action of their teammates.
10. Not playing at game speed. Players should always cut and move at game speed - which is also how they should practice their offensive plays. Failing to do this disrupts the timing of their teammates and the overall flow of the offense.

# Table Tennis

## How to Fix a Dented Ping Pong Ball


Ping pong ball in play

Try this easy task. What to do when your ping pong ball happens to become dented!

## Steps

## Flame method

1. Take the dented ping pong ball and find a helper who is handy with a lighter.
2. Gently run the flame under the ping pong ball so as not to set too much heat on it but just enough to cause a reaction.
3. The gases within the ball will eventually expand, fixing the damaged ball and causing it to revert back to normal playing standards.
4. Enjoy, relax, play on!

## Water method

1. Another, likely safer way to achieve this is to boil a pot of water, then put the ping pong ball on top of the water. When you take it out, do not let it just sit on one side, or it will be flat on that side.

## Tips

- Gently move flame of lighter back and forth

## Warnings

- Don't bring flame too close to the ping pong ball or let it touch the ball - it will catch on fire.

# How to Fix a Dented Table Tennis Ball

Its all too easy to squash your table tennis balls. One little dent and they are no good at all. But wait! Don't throw them away - they can usually be repaired.

## Steps

1. Look at the ball. If it is cracked or split then give up - it can't be fixed.
2. Just a dent? Great. There is hope...
3. Boil a kettle of water.
4. Fill a cup half way with boiling water.
5. Quickly drop the damaged ball into the cup.
6. Cover with a saucer, or something similar to keep the steam in.
7. Wait about 30 seconds.
8. Voila

## Tips

- You could use a jug or a mug, it doesn't have to be a cup.
- The air inside the ball will expand under pressure, because of the heat. This should push the dent out.
- Afterwards the ball will be as good as new. Tell your friends to be more careful in future.

## Warnings

- Be careful when handling boiling water!

# How to Play Ping Pong/Table Tennis


Ping-pong action

This article presents the basic rules of ping-pong (aka table tennis), along with tips for how to win.

# Steps

1. Find someone to play with; preferably someone who isn't very good. That way you can have fun learning how to play together.
2. To decide who serves first, usually you play a quick round and spell out the word P-I-N-G, you have to hit it back to each other 4 times before you try to get the round. Whoever wins "PING" serves first.
3. If you're playing singles, someone will serve cross-court and the other will return it. If you're playing doubles, you rotate the serve with your partner. Each team can score no matter who is serving. After a total of 5 points have been made, the other person gets to serve. After that, every 5 points you switch servers.
4. Most people like to play to 21 or 15, however, official rules say to play to 11; you have to win by two points.
5. When you start playing with people with more experience, you'll start to notice spin on the ball. That is done by flicking the wrist side to side or up and down. To counter spin put spin of your own on it. If you don't know how to put spin on something, politely ask the other person to show you; it's kind of hard to understand by just reading it.
6. If someone hit a ball high, don't be afraid to slam it. Hit with force so it goes fast, but try to keep in accuracy; many times you'll miss the table when slamming.
7. As you progress, start hitting your ball lower to the table, so that your opponent can't slam it to you.
8. Try to hit fast and accurate as well, you can always get a basket of ping-pong balls and practice your serve, so that you can keep it low and fast.
9. Try to constantly practice with a friend or a family member.

# Tips

- This list of rules:

- The ball is in play from the last moment at which it is stationary on the palm of the server's hand until the moment when:
    - it has, except in service, touched each court alternatively without having been struck immediately
    - it has touched one court twice consecutively
    - it has been volleyed
    - it has touched any part of the persons' body, except the racket hand
    - it has been struck by a player more than once consecutively.
- There will be a loss of point if:
    - a player fails to make a good serve
    - a player fails to make a good return
    - a player volleys the ball
    - a player is affected by the playing surface being moved by a person in play
    - a player's free hand touches the playing surfice while it is in play.

## Warnings

- Hitting the other person with the ping-pong ball can hurt. It is very painful to be hit by a slammed ping-pong ball. It can leave welts when playing a game of killer ping-pong.

## Things You'll Need

- Ping-pong ball(s)-you will find you lose them quite a bit
- Ping-pong paddle
- Ping-pong table, including net

# How to Serve a Ping Pong Ball With a Topspin

The topspin serve is a very effective serve. Its spin makes it very difficult for your opponent to return. This serve also requires you to throw the ball up. The spin of this serve allows the ball to accelerate faster. This is a common serve.

## Steps

1. Have your left foot facing the table.

2. Throw the ball about chest high.
3. As the ball drops in front of you, strike the ball below it.
4. Brush the ball in an upward and forward motion.

## Tips

- Make contact with the ball as lightly as you can, that way, the ball will have more spin.
- The ball should travel upward and have a fast speed, forcing your opponent to react faster.
- If you don't have a ping-pong table, you could still play using a table, such as your dinner table. You could place some books on the middle of the table, to make a net (official height = 6").
- You could also serve with a side spin, but before this, you should practice your topspin serve.
- The topspin is a simple serve, however, you should practice this serve more often, since this serve is a very essential part of the game.

## Warnings

- If you strike the ball hard, it will not do what you wanted, instead allows your opponent to have a plenty of time before he or she has to return it, as it will most likely to bounce high and slow.

## Things You'll Need

- A ping-pong paddle (a.k.a. blade or racquet)
- A ping-pong ball
- A table or a ping-pong table

# How to Win at Killer Ping Pong

This is a list of tips that will help you to best any opponent at an intense game of "Killer Ping-Pong".

## Steps

1. Make sure that you are reasonably comfortable with minor to moderate pain in the form of sharp stinging and somewhat lasting welts.
2. 

   Even Yoshi Gets A Bit Scared...

   Try to choose an opponent that is slightly worse than you at ping-pong so that when you play, you can win most of the hits against them.

3. Practice aiming; without this skill, it can be very difficult to win.
4. Know what it takes to win. You either need to get 3 hits in a row if you're playing to 15, or 4 hits if 21.
5. Realize that most people will not care what the score of the actual ping-pong game was. All that will matter is how many welts you gave the other person.

# Tips

- Try to be fearless, this includes going into the game with confidence; when you are about to be struck, have nerves of steal. (If and when you do get hit, it's ok to show pain but don't overdo it. It will only give the other person more confidence.)
- If you get hit and it hurts real bad, don't start the next round immediately. Try to lower the pain, otherwise you might be distracted, resulting in more pain.

# Warnings

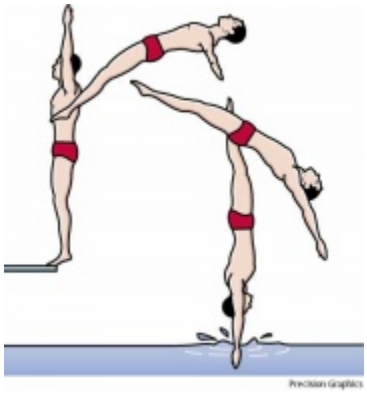
- Only aim at the back and not the head or face or other painful places. The back will recover much faster than a shot to the eyes or ping-pong balls.
- It will leave welts that go away in a couple days, most of the pain is in the first minute.

# Swimming and Diving

## How to Back Dive

Learn how to do a graceful back dive, and be the envy of all your swimming friends!

### Steps

1. 

   Practice, practice, practice. Do a forward dive a few times, then stretch out with a few bridges (lay on your back, then push up with you hands to arch your back).

2. Try back dives off a pool ladder, starting at the bottom rung and working your way up.
3. After you have a good "ladder dive," try it off the diving board. Go to the end of the board. Allow your heels to hang over the side and balance on the balls of your feet.
4. Arch your back slowly. When you begin to fall, throw yourself off the board.
5. Hit the water with your hands first. Keep your toes pointed.
6. Go a little quicker each time. When you are ready, you can add a bounce. Go to the end of the board, jump once, then go into a back dive.

### Tips

- Always have a spotter with you, to make sure you don't hit the board.
- Do a back dive with goggles. When you start to bend your back, try to watch the water. Keep your eyes open as you go in.
- Visualize completing the back dive. Confidence is everything!
- Dont fall straight down, but don't throw yourself way out. Try and go about 1 1/2 feet away from the board.

## Warnings

- Back flops will happen. These may cause redness and pain on the surface of your back. However, if your neck or shoulder hurts, STOP. You may have pulled a muscle.

## Things You'll Need

- a good front dive
- a pool
- googles (opt.)
- a spotter

# How to Become a PADI Certified Scuba Diver

SCUBA (Self-Contained Underwater Breathing Apparatus) Diving is a fun, exciting, and relaxing sport. It can be quite dangerous, however, if you do not have the proper training before diving. This guide will help you learn to dive quickly and safely.

## Steps

1. Consult your physician to make sure you're healthy enough to take a SCUBA course.
2. Find a facility near you that offers PADI-approved diving courses. (Refer to the PADI website in the external links section of this article to find the closest dive course.)
3. Contact the facility to find out which personal equipment you will need to own. Most dive courses provide most of the basic equipment but require you to own your own mask, snorkel, fins, boots, gloves, and hood. You will also need to purchase your course materials (usually a book and video) and your first dive log book. (The course materials and log book together will usually cost under $35.)
4. Purchase the required personal equipment. Most facilities that offer SCUBA courses are also dive shops. Be sure to save your receipts when purchasing your equipment, since many facilities will give you a discount on either the course or on future equipment rentals and air refilling services if you bought your equipment at their shop. The basic personal equipment needed for the course can cost anywhere from $200 to $500, or even more if you buy the fanciest gear.
5. Register for an open water diving course. The cost of the course varies from region to region, and may even vary greatly within one area. For example, in Massachusetts you can pay anywhere from $125 to $500 for a PADI open water diving course.

6. Usually a PADI open water diving course will include classroom sessions, swimming pool sessions (during which you'll learn to use your equipment in a swimming pool), and open water sessions. Some courses may do all of the water sessions in open water.
7. When you've completed the course to your instructor's satisfaction, you will receive your PADI certification card. Keep this card safe, since most dive shops will ask to see your certification card before refilling your air tanks or allowing you to rent equipment.

## Tips

- If you normally wear glasses, you may need to either wear contacts under your dive mask or purchase a prescription mask. Prescription masks are much more expensive than regular dive masks, but will be more comfortable (and safer) than diving while wearing contacts.
- If you aren't sure whether a full SCUBA certification course is right for you, ask the training facility about a "Discover SCUBA" course, which is much shorter and less expensive, but will give you an idea about whether you wish to continue.

## Warnings

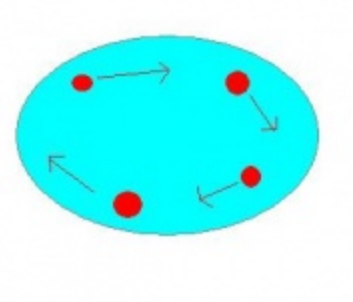
- Always follow your trainer's instructions *to the letter*. Diving accidents can result in serious injury or death, and most diving accidents are the result of carelessness.

# How to Create a Whirlpool in a Swimming Pool

A fun way to get swirled around your pool in just one minute.

## Steps

1. Gather up 3 or 4 friends (the more the better).
2. Space everyone arround the edges of the pool.
3. Have everyone swim (walk if shallow) around the pool as fast as they can.
4. Have fun! After doing several laps around the pool, stop and try to swim the other way, nearly impossible if done right with enough people.



## Tips

- For a stronger current, swim faster and longer
- The more laps and friends the better.
- Grip the edges of the pool helps to go faster.
- Smaller pools work better.
- This is a good leg strengthening excersise for Water Polo, as I have experienced with a full team, it was very fun.

## Warnings

- Don't drown! Real whirlpools can suck you under so be careful!

## Things You'll Need

- Friends
- Swimming pool

# How to Do a Dive

Don't know how to dive? Try following these simple steps to perform a basic dive.

## Steps

1. Stand at the edge of the water, keeping your legs and back straight.
2. Hold your hands together above your head, keeping your arms straight.
3. Face straight ahead, and don't bend your neck.
4. Bend your knees.

5. With your knees bent, fall forward until your hands are pointed at the water. Don't bend your neck!
6. Jump forward by pushing off with your knees, and keep your legs straight as you enter the water.

## Tips

- If at first you don't succeed, try diving from a kneeling position at first. It's the same idea, but you're not as far from the water.
- Once you can dive this way, try pushing off earlier and bending as you're in the air. This will let you get farther in the air and make your dives more graceful.

## Warnings

- Never dive in shallow water!
- Be careful when diving from smooth surfaces, as your feet could slip.

# How to Do a Back Flip in the Water

To back flip in the water you need to...

## Steps

1. Get into a pool.
2. If you are above 4 feet tall stay in about 4 feet or more.
3. Start to bend and pick your legs up like you are going to kick.
4. Pick up both of your legs high and tip your head back and push.
5. Keep pulling your head back and use your arms to help you.
6. Do a complete flip and come back up in a standing position.

## Tips

- Make sure you can hold your breath and swim.
- This will take time.
- Kids who can't swim should stay away from the pool.

- Practice until you come out of the water facing the same part of the pool as you were when you went under. Beginners tend to turn 90 degrees in either direction while flipping.
- To avoid getting water up your nose when you are upside-down, blow out air bubbles as you flip.

## Warnings

- Make sure the water is deep enough. Most pool floors are hard. Your forehead doesn't like hard things and if you're in a public/community pool, the floor is more than likely rough, which can scratch you

# How to Do a Forward 1 and a Half Flip Dive

This a very simple but exciting move.

## Steps

1. Go to your desired spot on the board where you start your approach.
2. Take a moment to relax and visualize the move.
3. Go ahead and do your approach.
4. As you jump and leave the board, get height first.
5. To get height off a board, jump on to board, landing near the front edge, then ride the board down with your knees flexed, ready to jump a second time. Once the flex of the board bottoms out and starts to rise begin your second jump. The effect is that the energy of your two jumps combine and you get much greater height than a single jump.
6. As you're in the air, throw your arms forward and hold on to the tuck position. The arms are the key to any flip. For a forward flip, begin the jump with your arms already up, hands almost touching your neck and elbows forward. As you come off the board, THROW your hands forward hard as though you are trying to launch a ball overhead. Bring the hands all the way to the knees. The speed of your spin will depend on how far back your arms were and how tightly you tuck (bring your knees up to your chest)
7. This should give you enough momentum to go into the 1 1/2 flip dive.
8. When you're coming down from the 1 1/2 kick out from the tuck, keep your toes pointed, keep straight and complete the dive.

## Tips

- Get height first, *then* jump out. Height off the board is controlled by how hard you make your two jumps and the timming of them. Distance off the board is controlled by how fast you were moving forwarding when making the jumps.

## Warnings

- Get far enough from the board so that you don't smack your head as you're coming down.

# How to Do a Gainer off of a Diving Board

Frontflips are pretty easy to do on a diving board, but running forward and doing a backflip into the pool is much harder. Here's how to do it.

## Steps

1. Start at the back of the diving board.
2. Run to the end, spacing your steps so your strong foot is the last to plant on the diving board.
3. Jump up and forward, and pull your knees to your chest and look backward.
4. While rotating backward, look for your landing (the pool), you'll be blind for most of the flip, but find the water as soon as possible.
5. Don't open your body from the tuck position until you feel you have rotated enough, otherwise you can land on your head or stomach.
6. Its imperative that you force your body forward before rotating backward, if you don't you could wind up hitting the diving board or even slipping before you jump.
7. When you find the water, open your body and land straight into the water.

## Tips

- *Always* envision yourself landing the gainer. Confidence is key, brah!
- Running forward always helps you gain a forward momentum so you don't hit the diving board.
- Learn how to do a frontflip and backflip before trying this, this flip requires more rotation and blocks the landing from view during the flip.

## Warnings

- *Never* do this under the influence of alcohol or drugs. You can die or become paralyzed!

# How to Do a Handstand in the Pool

When you are able to go underwater, you are ready for this:

## Steps

1. Go under the water.
2. Start a somersault with your knees tucked to your chest and stop when you can touch the bottom of the pool with your hands.
3. Put both your hands flat on the bottom and kick your legs straight up!
4. That's how easy it is.

## Tips

- Trying to "kick" up from a standing position simply doesn't work because of the water resistance.
- To stay up longer move your hands around on the bottom of the pool to keep your balance.
- Push on the bottom with your hands to come up again.

## Warnings

- Be careful not to hit your head - paralyzation or death could occur
- Please do not attempt if you are unable to swim

# How to Do a Springboard Back Suicide Dive

This is a dive that a lot of people can't do. A suicide means a dive without your hands. It's really easy though. This is the first step to a back flip.

## Steps

1. Walk to the end and turn around with your back towards the pool.
2. Stand with your heels hanging off the edge. Your weight is on the balls of your feet.
3. Slowly fall backwards.
4. Once you start to feel yourself going backwards, push off the board.
5. While pushing off, arch your back and tilt your back as if you were going to look at the water.
6. Keep your back arched and your head back as you're jumping.
7. Land in the water with your hands by your side and your feet together in a perfect line.

## Tips

- Don't be scared, you might land on your back but the pain goes away.
- If you start landing on your stomach then bring your legs over and back-flip.
- Good luck!

## Warnings

- **This is very dangerous. Have someone who can do a back-dive watching/spotting you to make sure your head doesn't hit the board.**

# How to Do an Open Turn in Swimming

Breaststroke

Learn how to do a butterfly and breaststroke open turn. This is a crucial move to learn if you're going to be racing.

## Steps

1. On your last stroke of butterfly or breaststroke (about half a body length away from the wall), put your head down so that you are looking straight down at the bottom of the pool.
2. Extend your arms so that you are trying to reach for the wall.
3. When you touch the wall, pull yourself in slightly. Now you can breathe.
4. Drop your left arm to your side (bend it), and (at the same time) pull your legs into your chest. Make a ball (make sure your feet are on the wall).
5. Let go of the wall with your right hand and bring it over your head.
6. Make a streamline.
7. Push off from the wall with your legs.
8. Turn onto your stomach.
9. Glide for 1-2 seconds.
10. If you are doing butterfly, start kicking. Do about 4 dolphin kicks and then begin to swim butterfly. If you are doing breaststroke, start your pull out.

## Tips

- Do not kick when you are reaching for the wall or gliding off the wall.
- You must touch the wall with both hands at the same time.

## Warnings

- Only do this if you are healthy enough for cardiovascular exercise.

# How to Dog Paddle

How to easily dog paddle silently and speedily.

## Steps

1. Start in the really shallow end. Later you can move to the deeper end.
2. Poise yourself with your mouth right above the water.
3. Push off of the wall.

4. Keep your arms in front of you. Not out to your sides, you will sink forward if you do.
5. Paddle one arm at a time, preferably slowly.
6. As you get better, move to the deep end.

## Tips

- Keep your hands below your chest.

## Warnings

- Don't swim after you eat! You might vomit

# Exercise to Become a Better Swimmer

If you find yourself getting out of breath before you finish a lap, maybe you need to try some new techniques in the pool. This guide will help you to improve your swimming easily.

## Dry Workouts

1. Do other exercises/sports besides swimming to build muscle and endurance. If you're going to be serious, you should devote all your free time to this. When you're not swimming, and not at work or school, bike, run, or do a similar sport.

Soccer is great, and you can try gymnastics/acrobatics if you are feeling confident.

2. Perform a variety of exercises every morning and evening that suit your style.

    - Breaststrokers and flyers should be doing a lot of leg exercises, squats, squatting jumps, and weight exercises, but don't use weights heavier than 10 lbs.
    - Freestylers and backstrokers should concentrate on their back and core muscles, and a little on their arms. Do the planck (get down on your toes and elbows, similar to push up position, and try to keep your body as straight and rigid as possible, and hold for a few minutes) a lot, as it is great for abs, back, and obliques.

# Wet Workouts

1. Work with a coach whenever possible.
2. Pay attention to your breathing. Don't breathe too much. When racing, freestylers should be taking no more than 7 breaths every two lengths for short distances like the 50 and the 100, and for longer distances they should be breathing every 3 to 5 strokes. Breaststrokers should breathe every stroke, and flyers should breathe every 2 to 3 strokes. Flyers and freestylers should never breathe inside the flags.
3. Reach as far forward as you can during your stroke. If it helps, pretend that you're four, and you can't reach the cookie jar, and you really want a cookie.
4. Kick hard; pretend your legs really tickle, and you just want to get rid of the tickly feeling.
5. Remember that when racing, the wall is your only friend, and that during a race, your sole objective in life is to reach the wall. Nothing else matters.

# Tips

- Always have drinking water available.
- At a swim meet, only eat things that will replenish the chemicals in your body but not be too heavy. IE: trail mix, dried fruit, etc.
- Before racing, think about your race. Don't talk to anybody, think about everything you practiced, and concentrate.
- If during practice there is someone better than you, because they are older or have more skill, you should ask them for pointers and tips, as usually it is taken as a compliment, and you will seldom be turned down.

## Warnings

- Never use weights more than 10 lbs, as you *will* hurt yourself, no matter how big your muscles are.

# How to Float on Your Back

How to float on your back in some simple easy steps...

## Steps

1. Choose a good spot in the pool. When you are in the pool go to the space that you are most relaxed with.
2. Ask someone to hold your back; it wil look like you are floating already and you will get the feel for it.
3. Take a big breath and don't let it go; when you are sure that you are ready, let the person let go of you.
4. Try to balance all of your body evenly. Spread out your arms and legs in a star shape and keep as straight as you can without becoming rigid. Remember, floating is about relaxing and remaining buoyant at the same time.
5. Watch the clouds, the tree tops and listen to the water gently lapping at your ears. It is a very peaceful thing to do, floating...
6. Keep practicing until it feels right.

## Tips

- Don't tell the friend that you want to float; just think that you already are floating and when your friend lets go it will be no problem.
- Make sure you can swim before trying to float. It will help to improve your sense of balance and gives you confidence if you feel yourself falling.

## Warnings

- **Be careful!** Don't do this in the deep end do it if you're learning and don't do it without others around to help you.

# How to Free Dive

Follow these instructions, and with some dedication, you could be diving down hundreds of feet below the surface.

## Steps

1. Time your breath-holding capacity underwater, and record it for future reference.
2. Take your pulse rate by putting both your index and middle finger together and either hold on your wrist or side of neck. You only need to apply slight pressure and wait a few seconds to feel slight "pumps" count for two minutes. Divide this by 2 (makes for a more accurate pulse rate) and you should now have your pulse rate. Record this and keep track of it.
3. Figure out how far down you can go on one breath, but do it with a partner in case of blackout. Record this depth.
4. Practice taking slow, deep breaths -- 10-15 seconds or more on the inhale and the same on the exhale. After you've mastered this, remain still and do it while having somebody else record your pulse.
5. Practice this until you can hold a pulse of under 80 beats a minute before starting the next step.
6. Try going down after deep breathing at the same location you did your last dive. If you went down 7-10 feet the first time, try to get it to 16 feet, 11-19 feet try to go to 25 feet, 30+ just try to beat it by ten feet.
7. Try practicing the above steps over and over. Your pulse should get to 60 or below after about a month, so try getting fins and testing how far you can go.
8. Practice slow, deep, refined kicks with the biggest fins you can find and you will go down faster with fins later on.

## Tips

- Bigger fins are a bit easier to use.

## Warnings

- Do not ever dive unless you are with someone who could rescue you from the depths you'll be going to.
- Do not try this if you have heart or lung problems.
- Never dive at night or in a strong current area. Currents get significantly stronger farther down.
- When diving deeply (below 20') your lungs compress enough that re-surfacing may be harder than expected.

# How to Get the Most out of Your Taper

Ah, taper. Just mention that word to any competitive swimmer and you'll see his eyes light up. Here's how to get the most out of your taper so that when the day of the big meet comes up, you'll be rested and ready to race!

## Steps

1. Get approval from your coach on whether or not you can taper. Most swimmers start tapering when they turn 12 or 13 and a week or two before their A/B/C Final or State Meet. Most coaches will know what's best for you.
2. Don't waste your energy. After beginning your taper, you'll probably find yourself full of energy. Don't go out and run 10 miles just because you feel like you can or stay up all night. Go to bed at your normal time and try not to exert yourself.
3. Eat healthily. Don't eat too much because since your practices will be getting easier, you won't burn calories as quickly. Snack on fruits, vegetables, and anything high in protein and carbs. Cut down on sugar and sweets.
4. Drink plenty of fluids. The reasons should be obvious.
5. Stick with your routine. Keep going through your days as you would without being on taper. This means eating around the same time and going to bed at a reasonable hour. Try not to do anything drastically different from your normal daily life.
6. Continue to stay in shape, even if you shouldn't over-exert yourself. Don't spend the whole day just lounging around and watching t.v. Get up and stretch a little and do a couple crunches.
7. Stretch yourself out for the race. If you always go to pool on a Friday, go! Even if you have to race later that afternoon. Do a couple of long swims and get yourself stretched out. Stretch again right before the race.

## Tips

- Foods that you can eat are bagels, apples, grapes, peanut butter, and crackers. Anything high in protein and a little bit of fat is good.
- Don't eat candy, ice cream, doughnuts, and muffins. Anything high in sugar and calories is a big no-no. Of course if you're a swimmer, you should already know this.
- Enjoy your taper! It only happens once or twice a year.

## Warnings

- After the big meet don't go straight into grueling workouts and eating tons of food. You'll get sick! Build yourself slowly up.

# How to Have a Watergun Fight

This is a great way to cool off and have loads of fun on a hot day. Invite your friends and family! The more the better in this water-blasting, all-out-squirting, perfect-for-a-summer-day game!

## Steps

1. Start by organizing a list of who you want to invite. It helps if you make this an even number of people for equal teams.
2. Call/leave a message to inform them of your fight and let them know what to bring.
3. Have these people call you to RSVP.
4. Once you've called everyone, you should probably make sure your watergun works.
5. WATER BALLOONS!!! This is a definite must. A water fight without water balloons is boring. Go get some. (It's a good idea to have 50 or so pre-filled for when your guests come.)
6. On the day of the water fight you should tell them the rules.
7. This is an example of guidelines, but you can make your own rules: [a] Set boundaries [b] Develop teams [c] No headshots with balloons [d] Have fun [e] Provide snacks for afterwards.

## Tips

- If you plan your attacks and your objectives, it makes it more fun.
- Poke the top of your water balloon where you tied it. This way it'll explode almost every time.
- Little old-fasioned water pistols ARE effective.
- Go for the driest people.

## Warnings

- Getting water in your eyes hurts. (But, hey, it's part of the game.)

## Things You'll Need

- An even number of people
- Water guns for everyone
- A big yard
- Plenty of hoses for refills
- Water balloons

# How to Hop Fences to Go Skinny Dipping!

Breaking into apartment complex pools can be an exciting and invigorating way to "beat the heat". With this easy to follow guide, you will be enjoying a nice naked swim with friends in no time!

## Steps

1. Find a low-traffic area of fence that is accessible to climb over. This is easier if you are not wearing pretty silver sandals or a long black skirt. This is also easier if the fence is not chain-link (which hurts your feet!) and spiky at the top. Work with what you've got though - with a little courage and agility, any fence is scalable!
2. Once you are inside the fence, the pool should be within your reach. Get excited!
3. Start skipping or running or even slowly walking towards the water, all the while, taking off items of clothing. I find it best to slip your shoes off first, then you can basically start flinging your other clothes wherever you want. Remember, the pool is yours for now! The goal is just to get naked and in the water as quickly as possible!
4. SKINNY DIPPING = NO CLOTHES. I really want to reinforce this one because I feel that this is an especially important aspect of skinny dipping. Sometimes people think it's okay to say, "hey! let's go skinny dipping!" and then leave their underwear on while the rest of us play by the rules. How not fun is that?!? Just get naked!
5. If you are so inclined, feel free to utilize any diving boards and/or life guard stands as platforms to fling yourself into the cool refreshing water from. This is especially nice if the moon highlights your lovely nakedness as you stand proudly above the water...
6. Above all, enjoy swimming with your friends, naked!

7. After a period of time, you will need to remove yourself from the water. Use the pool ladder to your advantage.
8. Towel yourself off if you happened to bring one, then begin putting your clothes back on. I know it's sad... but remember that skinny dipping is free and easy. You can go again!
9. Head back, picking up aforementioned clothes you have strewn about the area.
10. Go back over the fence. Be very careful! If you run into someone you know, be casual. Act like you're supposed to be climbing over a fence at an apartment building that you don't technically live in.

## Tips

- If the fence you are climbing is indeed chain-link, throw a towel over the top right away so you don't rip your favorite black skirt and/or your legs. Don't wait until everybody except one person has gone over to think of such an ingenious idea.
- The less clothes you have on, the easier and quicker it is to get in the water without them.
- While fence hopping and skinny dipping can be done at any hour of the day, it's a lot easier and more thrilling to do it at night! Plus, everyone looks prettier at night!
- If one of your friends is prone to panic and feel very anxious due to the fear of getting caught, feel free to remind her in your best "i AM being quiet!" voice that A. you ARE being quiet and B. you didn't mean to break the rope and C. no, we are not going to get caught and D. even if we did get caught, we will not go to jail, i promise. After awhile, she should be calm enough to enjoy herself : )

## Warnings

- Watch out for cars! Nobody wants to be standing on a life guard stand about to gracefully swan dive into the pool and be caught in the glare of headlights! That does not rock! (and the driver might think it would be a good idea to turn you in, thereby putting a real damper on the night. not cool.)
- Be aware of security guards or other people who would gladly ruin your fun all in the name of "doing their job".
- Since it's dark out and you can't see that good, beware of rough cement edges in the pool that could possibly tear your toe open. Nobody likes a hurt toe.

# How to Jump off a High Spot Into Water

Do you know of a cliff or structure that towers over deep water and have you ever been tempted to jump off of it? Here's how to do with relative safety.

# Steps

1. Fi

Intermediate level jump near Borrego Springs, CA

nd a suitable cliff or structure, between 30-50 feet high, perched over deep water.

2. Swim or wade out to the landing target to make sure that it is deep enough (at least ten feet) and there are no underwater obstructions that you may hit.
3. Climb up to the top of the cliff and take a few deep breaths to get your nerves up.
4. Keep your eye on the target and jump for it.
5. Cross your legs while in the air and cross your arms over your chest.
6. Cup one hand under your chin to protect yourself from whiplash and to keep water from bursting into your nasal cavity.

Advanced Jump -this is a 100% real photo.

## Tips

- Jump with a partner (not at the same time though) so that you can have someone to spot you.
- Start with very small jumps (10 feet or less) and work your way up as you gain experience.
- If the landing spot is relatively shallow (less then 10 feet), then you should do a 'Banana Maneuver' and thrust your legs out slightly after impact so that you arc over, parallel to the bottom, rather than going stright down.

## Warnings

- Jumping off high objects into water can be extremely dangerous, if you do not have experience and confidence in yourself to make it, don't do it.
- Never let anyone dare you into such a jump. It should be your own choice.
- Do not plug your nose with your fingers. The impact could cause you to damage your nose. Simply cup one hand under your chin to deflect the initial spash from your nostrils and eyes.
- Do not lean forward. A bellyflop could cause serious injury. (cliff diving is a seperate activity and is not covered in this how-to)
- Jumping off anything higher than 50 feet is typically called base jumping and can be extremely hazardous.
- Do not drink alcohol beforehand to get your courage. Even a slight lapse in judgment and timing could spell peril. (besides if, you're to scared to do it while sober, then you shouldn't do it at all)

# How to Pack a Bag for the Beach

Are you going to the beach? Pack the ideal bag, including all the essentials you could possibly need!

## Steps

1. **Sunscreen** - Choose a factor that is going to protect your type of skin from the sun. And when you put it on, use quite a lot and remember all the forgettable places like your feet and neck.
2. **Hat** - If you aren't already wearing one, make sure you pack one! As you can imagine, its hard to put sunscreen on your head, so wearing a hat can protect your scalp.
3. **Cell phone** - For emergencies or for if people need to get in touch with you.
4. **Book** - For the beach, it would be very handy to take a book, magazine or something to read. It beats summer boredom!
5. **Spare hair bobbles** - Incase you lose yours, and the sticky heat is making your hair cling unbearably to your neck and face.
6. **Change** - For the ice cream van if you want to get refreshed, to buy drinks or to use a pay phone in emergencies.
7. **Sunglasses** - To protect your eyes.

## Tips

- Make sure you keep them in a reasonably sized, strong bag that also looks good on the beach!

## Warnings

- Do not ever forget your sunscreen!!!

# How to Perform a Back Dive With a Half Twist

This is probably the first twisting dive a diver should learn...and performing it is great fun!

## Steps

1. Walk to the end of the board, watch the water behind you (this is optional), and turn your back to the water.
2. Stand on the balls of your feet.
3. The first times you try this dive, start with your arms straight above your head and close to your ears.
4. Drop your arms to your sides while bending your knees.
5. At the same time, swing your arms back up to your ears and push off the board. You don't want to jump straight up, because then you will hit your the board on your way down. However, you also don't want to jump straight back. Try jumping as high as you can in the air and about two to three feet back, depending on how tall you are.
6. Once in the air, you have three options for your body positon - tuck, where your knees are tucked tightly to your chest, pike, where your body is bent at the hips and forms an "L," and layout, where your body is completely straight. Layout is the easiest to twist, but it takes the most effort to complete the flip.
7. Unless you are very comfortable with this dive, do not attempt to tuck or pike. For a layout, once you are in the air, tuck your chin to your chest and focus on pulling in your stomach muscles and straightening your back, helping your feet go over your head.
8. When you are completely vertical, (but upside-down over the water,) you're ready to twist. If you are a lefty, snap your right arm down towards your left hip, keeping your left arm straight. As your arm turns, turn your hips. The turn will be completed. If you are a righty, snap your left arm down towards your right hip, keeping your right arm straight. As for lefties, your hips should turn with you arms and your turn will be completed.
9. You should now be facing forward. Make sure both arms are by your ears. You can untuck your chin now. Enter the water with your arms up, your toes pointed, and a big smile!

## Tips

- Your stomach and back muscles play a bigger role in this dive than you think. Keeping them tight is essential to good form.
- Do not attempt a tucked or piked position in this dive unless you are very comfortable with the layout position.

## Warnings

- Springboard diving is a dangerous sport, so have a knowledgeable person help you.
- Always check the water depth before diving!

# How to Perform a Breaststroke Turn

If you follow these steps, you will become an awesome turner and beat most everyone in the pool.

## Steps

1. Make sure that, about five feet away from the wall, you are completely stretched out. Don't shortstroke yourself. Keep your head *down* and looking at the bottom of the pool. you should be ready for your fingers to touch the wall.
2. In a fluid movement after you touch the wall, jab your non-dominant arm back with karate force. This will send your feet flying up into your chest.
3. At the same time as # 2, bring your other arm up by your ear. If you need to breathe, you can do it here as your head comes out only for a little.
4. When your feet are completely planted, push off with as much force as you can. Please note that at one point, your hands are off the wall before your feet touch the wall. Make sure you utilize as much of the push off as possible.

## Tips

- Streamline!
- Practice each step one at a time. Practice makes perfect.
- Remember, you are faster off the wall than you are swimming. Take full advantage of this.

## Warnings

- Keep your bicepts on your ears. Stay long and streamlined.

# How to Play Sharks and Minnows


Shark
Sharks and Minnows is a rough but fun game to play in the water, as long as you and your friends are all good swimmers.

## Steps

1. Pick one player to be declared the Shark, and the other players get up onto the pool deck in a line across the pool.
2. Yell "swim minnows swim," if you are the shark, and the players on the deck will dive in and try to get to the other side.
3. Try to catch a minnow and drag them to the surface of the water (this person will join the Sharks team).
4. Keep going until there is only one person left on the Minnows team.
5. Declare that person the Shark in the next round.

## Tips

- Minnows, try to get across the pool in one breath.

## Warnings

- This is only for good swimmers who can stand the toughness of the game.
- Always play with a lifeguard present.
- Don't play this in a crowded pool with other swimmers - you might hurt someone or get hurt by accident.

# How to Prepare for Your First SCUBA Dive


Two divers enjoying the sea

So, you've got your SCUBA certification, you've got your SCUBA gear, and now you're itching to go on your first SCUBA dive. And sure, the certification process reviewed all the basics, but there are still other practicalities that an informed diver should know. This article will outline the methods and precautions observed by safe divers around the world...

# Steps

1. **Select a suitable location.** Many variables factor into where you may want to hold a dive, such as:

    - Attraction - There are many sights under the water including coral reefs, shipwrecks, caves, and any assortment of plants and animals. Coral reefs are found mainly in tropical climates. Shipwrecks and caves can be found almost anywhere.
    - Visibility - Under the water, visibility can vary from as little as 2ft. to over 100ft. This depends mainly on sea conditions, but can be affected by weather as well. In the Northern Pacific and Northern Atlantic, you will find visibility to be very limited, while in tropical climates, you can see the sun from over 100ft down!
    - Depth - Recreational divers should not dive below 100ft without advanced training and equipment. The deeper you dive, the higher the risks for injury. As you go deeper, less light can penetrate the water and the ocean becomes darker. Also, the deeper you go, your risk increases of getting Decompression Illness. These conditions may be very stressful for a beginning diver. It's recommended that you dive no deeper than 60ft until you become more comfortable with scuba diving situations.
    - Temperature - Scuba divers often wear wetsuits to protect themselves from the cold. In most parts of the ocean, there is a temperature gap where in a change of depth of 1 foot, there may exist a 10 degree decrease in temperature, this is called a Thermocline. In some circumstances, in tropical climates you will need only a bathing suit.
    - Water Conditions - Surf and current are the basic sea conditions you need to know. Current can be very strong in some areas and can carry a diver

away. Even many popular dive sites have very strong current suitable only for experienced divers. Be sure you know how strong and in which direction the current is flowing. Surf can affect the boat and how safe it is getting in and out of the water.

- 

  Spotted Trunkfish

  Wildlife - Observing the local wildlife can be the most rewarding experience of an underwater dive, but it can also be quite dangerous. Every geographical location on Earth has its own unique species. You should know the basic fish and plant life you are likely to encounter and if there are any precautions for dealing with any. Just about all of them are harmless and are more scared of you than you are of them.

2. **Do your homework.** Thorough research is needed to select the best location for you. While objective research such as charts and diagrams can be helpful, there is no substitute for professional advice and experience. Any location with good diving has one or more dive shops. These local professionals know the sites and dangers better than anyone. Always seek local advice including infomation about currents, tides, visibility, depths and hazards. Before you go, you should know the local weather. Some important questions to know are "Does it storm regularly?" or "How fast do storms arise in this location?"
3. **Prepare suitable gear.** Selecting and ensuring the proper operation of scuba gear for the water conditions is critical to the success and safety of a dive:

   - The wetsuit - The thickness of wetsuit you use should depend on the temperature of the water. Selections may include 3mm, 5mm, or 7mm thicknesses. The colder the water, the thicker the material on your wetsuit should be. The same is true for the hoodie, gloves and booties. The wetsuit not only provides cold-water protection, but also protection from stings and abrasions from underwater animals. Be sure to select a neoprene suit that fits you well and provides ample flexibility, as an improper fit can cause comfort and mobility issues.
   - Fins, or swimfins - Purchase fins with wide channels, as scuba divers require these to overcome water resistance with more equipment. The most commonly used fins contain a strap that fits snugly above the heel,

although in some warm water conditions, a shoe enclosure type fin will be ample. The difference between a full-foot and open heel fin can be drastic-- so be prepared with whatever you choose.

- Buoyancy compensator device(BCD) - This equipment allows the diver to achieve neutral buoyancy underwater as well as provides assistance in ascending or descending. Ensure proper operation of the BC before any dive, as this is a primary piece of safety equipment.
- Weight belt - These will counteract the overall buoyancy of the diving equipment. Select a weight belt based on the buoyancy of both the equipment and yourself, which should be determined before attempting a dive. Ensure that the weights on the belt are secure and that the releases on the nylon belt are not jammed. Some newer BCDs have intergrated weight systems. Always remember when you are wearing weight, whether a belt or integrated into a BC, that you need a one hand release-- almost always a right hand release. Before every dive, make sure you can release the belt easily with your right hand.
- Scuba tanks, or diving cylinders - Select a tank tailored to your dive plan. For shorter dives in warm water with good visibility, generally only one aluminum tank filled to 80 cubic feet of air will be suitable. If you are diving for a longer duration, or the water visibility is low, or the water is colder and deeper (such as diving near shipwrecks), two tanks may be necessary.
- Regulator - These are designed to let the air out of the tanks in a controlled manner. Make sure yours has been serviced properly. Remeber-- regulators are designed, if they fail, to fail open, causing a lot of air to come out. You can breath that-- you will not just be cut off.
- Mask and snorkel - Be sure to use a mask that has been tempered for pressure and contains a nose enclosure. Ensure that the mask fits properly and is watertight to your face. Snorkels should contain a purge valve.
- Knife - Although optional, you should carry a knife in case of snags in fishing nets while underwater. Also, knives can be handy for other uses, such as prying rocks.

4. **Perform a final check.** Once you have prepared all of your equipment, you must now prepare yourself. Ensuring proper hydration is a key step to diving safety, as dehydration can be detrimental to your underwater health. Also, maintain a positive attitude and a clear mind in case problems occur while diving. Most of all, do not panic if something goes wrong!
5. **Determine how you will enter the water.** There are generally two ways of entering the water for a dive: from a boat, or simply by walking in from the beach. If you are walking in from the beach, ensure that you know the local sandbars and/or any coral or rock formations near your location. If you are entering from a boat, you can roll in backwards from the side, or jump in off of the rear of the boat. Remember to be careful when lowering the anchor because you do not want to damage coral or have it get tangled in a shipwreck.

# Tips

- Always be sure to fly the red and white striped diver's flag or the international blue and white Alpha flag while diving. Take it down when everybody is out of the water.
- You should know basic first aid.
- Have a physical done before you plan on scuba diving and make sure your health is good for diving. The better your health and physical condition, the easier diving will be for you.
- Always have a dive plan and follow it.
- Always dive with a competant buddy.
- Always have an emergency plan-- what happens if one person is missing? Where is O2? Where is the neares hospital? Who are emergency contacts?

# Warnings

- Your certification card only permits you to dive in areas similar to you checkouts. Before you dive unfamilar places talk to a local diver. They will be happy to tell you about local rules, conditions, and give their advice.
- Despite the fun and excitement of scuba, this sport can be hazardous without proper training and knowledge of open-water. It is important to note that before attempting any sort of open-water dive, you should be properly certified and should not attempt a dive without instruction.
- Some species should still be avoided, such as sea snakes, which have the world's deadliest venom. Plants can also be dangerous, as they can cut through wetsuit material very easily. Bleeding in the ocean may attract other organisms which live in the plants and coral, such as eels and other predators.
- Never enter the water near a jetty or pier.

- Find a buddy. Never dive alone!
- When coming up, make sure you do a 3 minute safety stop at 15 feet. You should never ascend faster then 30 feet a minute.
- Following a dive, do not fly for at least 24 hours, even in a pressurized airplane. Failure to follow this could result in decompression sickness or what many know as “the bends.  ? This time frame is not 100% accurate, but only a ballpark number to adhere to, and can vary based on the depth and bottom time of your dive. The best method is to advocate a “better safe than sorry  ? attitude.
- **NEVER** hold your breath when scuba diving; breathe normally to avoid hyperventilation or lightheadedness. Holding one's breath, while ascending, can result in serious injury or death.
- Never disregard pain or discomfort. If you are feeling unhealthy, do not dive, or abort any dive if you have excessive discomfort.

# How to Prepare for a Swim Meet

All swimmers know you need to be well rested for swim meets. You need to be rested but not tired and lazy. The tips that follow should help you to find a good balance.

## Steps

1. The night before a meet, you need a lot of sleep. Go to bed as early as possible, especially if you are getting up early.
2. If this is a taper/shave meet, do your shaving the night before. Remember your legs, arms, back, and chest if you're a guy. Yes, you do need to shave even if you are wearing a legskin, because the hair pokes through the one layer material.
3. Find a couple of friends and arrange to go to someone's house.
4. Cook something high in carbs, add some fruit and steamed vegatables. Be sure to eat an hour to two hours before your meet.
5. Find a movie, get comfortable and relax! Be careful not to watch it too long or you'll get lazy and tired. Take short intermissions and go outside.
6. Get your bathing suit on (half-way to the meet, you don't want your super-tight suit to hurt your shoulders. Even better, change at the meet) and gather your stuff for the meet. Be sure you have water and healthy snacks. If you are swimming both trials and finals, you are going to need up to five towels; however, you can hang up your towels to dry to save space in your bag.
7. Put on sunscreen. Remember, it takes 30 minutes to soak in. You don't want goggle tans, that's for certain.
8. ***Get pumped up for your meet!!!***

## Tips

- If movies make you sleepy, find a board game, or read a book.
- You should stretch before your meet; stretch for about a 1/2 an hour at home, doing arm swings, and stretching those quads, especially for breaststrokers.
- It's a good idea to elevate your feet for about an hour while you're resting. Lay on your back and put your feet up on a chair. Breathe slowly and deeply. Now is a good time to do visualization of your race strategies or relaxation exercises.
- Especially during the summer, you need *a ton* of water. Four to six water bottles should get you through the meet. Stick to one bottle of Gatorade, about a sip before/after races. Too many Gatorades will give you a sugar high, which means "let down" just when you need the energy.

## Warnings

- Don't eat too much. You might be sleep deprived but don't be tempted to carbo load to make up for the lost energy. Stick to a 3000 calorie diet on race days, and stock up on food *after*you are done swimming, especially foods high in protein. Too much food before a meet will weigh you down, guaranteed.
- Don't cut yourself shaving. *You don't need to press that hard!!* If you cut yourself, rub on some chapstick to stop the bleeding. Put on a band-aid, but remember to take it off before you race; it's drag.

# How to Prepare to Go Swimming

These steps make sure you are ready to go swimming.

## Steps

1. Find out where your nearest swimming baths is and find out times and prices. Decide if you are going alone or with friends and sort out where you are meeting etc.
2. Get a good sized, easy to carry, waterproof bag to hold everything.
3. Make sure you have a swimming costume that is not too tight or too loose. Try it on and check beforehand. If you like swimming underwater or feel that you need them, make sure you have some good goggles that fit you. Put them in your bag. If you want to wear one, pack a swimming cap.
4. Get a good sized towel and put that in your bag.
5. If you want to shower after you come out of the pool, put soap and shampoo into your bag. Also, pack a hairbrush.
6. If you want, take a bottle of water or a snack for when you come out of the pool.
7. If you are taking things like your mobile phone that cant get wet, take them in a seperate small bag, pockets of your clothes or a waterproof bag which you can put in your swimming bag.

## Warnings

- Make sure you follow the rules at the swimming baths and always be sensible in the water.

# How to Put on a Wetsuit

Wetsuits, ah, wetsuits .....they are the hardest darn thing ever to get on. Here is how to succeed.

## Steps

1. Make sure the wet suit is dry.
2. Unzip the back.
3. Place legs in proper holes and pull up.
4. Place arms in proper holes and push through.
5. Either zip up the back yourself or get some one to help you.
6. Jump in water and wait for the suit to get warm.

## Tips

- The suit should be a little tight, but not cutting off blood flow

# How to Skinny Dip

When it is dark outside and you're at a party on the lake, it always fun to go skinny dipping-safely, of course.

## Steps

1. Know where you're going. If you're going to be in a friend's backyard while her parents aren't home, you probably won't get in trouble. However, if you'll be swimming in a public pool, the administrators will most likely not be fond of that- or you.
2. Wait for the right moment. If you run to the pool, strip, and jump in while everybody's at the food stand, it won't be nearly as much fun. If it's a big party with music and dancing, you might choose to wait until a slow song comes on, then grab your boyfriend/girlfriend/crush, and go skinny dipping if you don't want to make a big deal out of it. However, if everybody's practicing their cannonballs,

and you're up on the diving board, and you take you're suit off at that moment, you'll make a bigger "skinny-dipping entrance".

3. When you decide when you want to dip, **do not go in the pool!** Stand on the ladder or on the side of the pool, and (for girls:) Slowly loop your arms out of suit. Make sure you have everyone's attention. Then fold the bottom of you're bikini top up as far as possible without showing anything. Move it around so that the "private parts" aren't showing, but everything else is. Slowly cross your arms so that your hands are on the bottom of the top, but keep your arms crossed. Close your eyes if you feel embarrassed. Then pull up your arms, and with them should come the suit top. (For guys and girls) Taking off the bottom is a lot easier. Just pull it off!
4. Jump in the pool! If you feel a bit embarrassed, being naked will slowly feel more comfortable. Also, you can encourage skinny-dipping for others. I've been to parties where, after being the first to take off my bathing suit, *everyone* skinny-dips and *everyone* is naked!

## Tips

- Girls, it's a lot easier if you wear a two-piece.
- If someone else is skinny-dipping, admire them! It's okay to stare at a beautiful body. If the person *weren't* okay with that, they wouldn't have taken off their bathing suit!

## Warnings

- Always keep your pool party out of the vision of young children.
- Make sure the place is appropriate.

# How to Swim

Once you get the hang of swimming it is really easy and fun.

## Steps

1. Get used to the water and temperature by ducking your feet in the pool. Slowly ease yourself into the water, making sure that it is not too deep for you. Holding on to the side of the pool, or someone you trust, let your head go under water. Remember to hold your breath. If you blow bubbles out of your nose then water will not go up it.
2. Grab onto the side of the pool & let your legs float out behind you. This will be easier if you put your face in the water. Start kicking your feet and get a feel for how it's done. When you're ready, stop kicking and proceed to step #4
3. Turn around so you are facing the open water.

4. Slightly jump off the ground and bring your right arm in front of you, cup your hand and push your arm through the water until it's at your side. Repeat the process with your other arm. You are pushing yourself through the water with your arms!
5. At the same time, kick with your feet, like you did in step #2. This will make you move faster!
6. If your arms get tired, Don't panic! You can flip over onto your back, let your arms float out to your sides, like a 'T', and let your feet float our in front of you. Relax, then just kick with your feet to keep moving.

## Tips

- Make sure there is another person present that is able to swim in case of emergency.
- You can also take swimming lessons at most public pools.

## Warnings

- Don't panic! If you get exhausted, flip over onto your back and float - as described in Step #6.
- Until you are comfortable in the water do not go into water that will be deeper than your chest. That way, if you get scared or tired, you can put your feet down without too much of a struggle.

# How to Swim Butterfly Stroke

If you swim competively it is important to know how to swim butterfly properly and also quickly.

## Steps

1. 

the stroke butterfly

Know your other swimming strokes first. Generally butterfly is the last stroke to be introduced when training for competitive swimming. It requires strength of body and endurance skills, which you should have been building up before through other strokes before attempting butterfly.

2. Do the butterfly streamline kick when you first dive in. The butterfly kick consists of putting your feet together and kicking continuously in a fluid wavelike motion.
3. Place your hands alongside. When streamlining, keep hands at your sides.
4. Bring up your head after the dive.
5. Get your arms into action. When your head breaks the surface proceed to moving the arms. You perform the arms by making a large circular scooping motion that extends your arms back first and then brings them up out of the water, directing them right over in an arch-like shape and then diving back in to the water, pointed hands first.
6. Kick once underwater before breathing and extending arms out again.
7. Once you hit the wall, touch with two hands and push off. Not doing a two hand touch will result in a disqualification, so remember!

## Tips

- Practice makes perfect, especially with this stroke, so try and try again.

## Warnings

- Do not be discouraged; although this is a hard stroke for most, you are fully capable of achieving a 50 meter swim in 27 seconds when fully competitive.
- Don't eat before swimming. Butterfly is a very tiring stroke, be sure not to eat before swimming, to avoid cramps.

# How to Swim Free Style Correctly

You could get a swimming coach. But this is always easier.

## Steps

1. Use your arms and legs. Pull wtih your arms, and kick with your legs.

2. When you pull your arm out of the water, push your arm almost straight on the surface of the water. Just enough to go in the water and pull efficently.
3. Point your feet down, so they're horizantal.
4. Kick on the surface of the water.
5. Roll you shoulders. When you pull, use your shoulders to reach farther. For example, when you pull with your right arm, push your right shoulder forward with your arm.
6. To breathe, pull with one of your arms and turn your head to the oppisite side. Breathe when your mouth is out of the water. For example, when you pull with your right arm and you have to breathe, turn your head to the left and breathe after your mouth reaches the air.
7. Keep your head center until you have to breathe. Turn your arms and shoulders when you take a stroke, and don't move your head with it. Only move your head if you have to breathe.
8. To start off a wall, or push off, hold the wall with one hand and point one arm out to where you're going to swim. When you go, push off the wall with your legs and go into a stream-line. Start kicking. When you reach the surface, go into normal free-style.
9. To start of a block, grab the end of the block with both of your hands. Put on leg back and one of the edge with your arms. Put your butt up. When your told to go, use your arms and legs to launch yourself from the block. Go into stream-line and tuck your chin into your neck.
10. To do a flip-turn, you have to flip when you get to a wall. To do this, push your head down like you did when you tucked your chin when you started off the block. Bend by using your waste to go down, this will start the flip. Your knees will be on your chin after you bend your waste. Put your heels on your butt to let the flip follow through. You'll be on your back when your done with it, so push off on your back a turn over while your in stream-line and gliding off the wall.

# Tips

- Take short, quick breaths. You'll go faster.
- When you start off the block, tuck your chin into your neck so you don't loose your goggles.
- When you do a flip-turn, blow air through your nose so water doesn't get in it.
- A coach is always better than the internet.
- Practice, practice, practice.

# Warnings

- Don't forget to kick, it's harder than you think.

- Don't forget to breathe when you have to.

# How to Swim the Breaststroke

The breaststroke can be a tricky stroke to master, but once the steps are coordinated correctly it can be a very leisurely way to swim.

## Steps

1. Place yourself laterally in the water with your arms extended straight in front of you and your legs in back of you. Make sure your face is submerged (not your whole head) and looking directlty at the bottom of the pool.
2. Push your arms apart so that they create a diagonal with your body. Make sure your palms are facing out and your elbows are straight.
3. Pull your elbows into the sides of your body, then bring your hands together in front of your chest. Now simply push your hands forward so they return to where they started.
4. While completing step 3, lift your head, neck, and upper chest out of the water to breath. Do not remove your hands from the water.
5. Bending your knees, bring your feet towards your bottom. Make a circular motion with your feet until they meet with your legs fully extended once again.
6. Glide.

## Tips

- Remember the mantra "pull, breathe, kick, glide" while you are swimming.
- Do not be tempted to rush through the glide; it is actually the fastest part of the stroke.
- Keep your feet flexed while kicking. This provides more power to the stroke.
- For more speed, breathe between the pull and the kick as fast as possible. In the stance during the stroke when you breathe, there is resistance that can be removed if the pull, breathe, and kick portion are made in a fluid non-stop movement.

## Warnings

- Keep your hips away from the bottom of shallow pools; this could result in serious injury to the feet, legs and hips.

# How to Swim when You Are on Your Period

When you are planning a day at the beach, who looks to see if they will be on their menstrual cycle? This article is for times like these, so that you can still enjoy your day out.

## Steps

1. Use a diaphragm or cervical cap. For those of you who have a diaphragm or cervical cap lying around, we just found another use for them. Instead of keeping unwanted things out, you will be keeping them in. Just remember to use the cervical cap for just a few hours and the diaphragm for up to 8 hours.
2. Wear a tampon. If you're not too comfortable with using any of the above methods, you might be interested to know that you can swim while wearing a tampon. This method is most effective and has a 100% safety factor. The average tampon absorbs blood for up to 8 hours (depending on your blood flow).
3. Just wade. If you don't like either of these options, wear a nice pair of shorts or a pair of skorts and simply wade in as much as you can. You can still be around your friends and you don't need to make any detailed explanations - just say that you think the water's too cold or that you're not feeling up to swimming that day. Beware the spoilsports who might try and pull you under though!

## Tips

- The tricky part about this whole thing is that the removal can be messy. You can do this by going into the shower or bringing a plastic ziplock bag (and a paper bag to conceal the contents) with you. Now you can still have your day at the beach
- If you are not a cervical cap or diaphragm user, there is a new product on the market, called *Instead*. You can find *Instead* in most stores in the feminine products area. Just follow the directions and you're covered for up to 12 hours!
- Other ways you can participate without actually going into the water include sitting on the end of the jetty/pier and tossing in balls/rings etc that the other swimmers have to catch; being a "race" official on the shore; preparing the picnic spread (but get the others to clean up after!); holding the hands of any small kids who might come along and helping them to enjoy their day at the beach. Don't stay at home just because of a period; there's still a lot of fun to be had.

## Warnings

- Not all girls are suited for wearing tampons. Locking in the blood flow often causes depression. Therefore, it is recommended that the tampon is tried for a minimum of 3 days to ensure comfort and practicality. For some people, even the thought of using a tampon is offputting - don't worry, there is no pressure to try.

# How to Teach Swim Lessons

When I was at college, our Physical Education lecturer taught a very nervous ex-policeman in his 40s to swim in half an hour! His method was very simple, but it worked like a charm. The privacy of the college pool was a bonus.

## Steps

1. Have the student sit on the edge of the pool
2. Get into the shallow end
3. With your help, ease them into the pool and assess their swimming skill before letting them go further
4. If they are comfortable, begin by getting them to swim one metre (from the edge of the pool to your arms), then progressively increase the distance as they improve

## Tips

- You need to be responsible and serious about teaching others how to swim. One wrong move and a little kid might be traumatized, and you don't want that! Once you get into it, you'll be having so much fun!

## Warnings

- Swim aids (such as kickboards) can make learning to swim fun, and assist in practicing skills like breathing technique and kicking. They should NOT, however, be relied upon to keep a non-swimmer afloat -- it is the instructor's job to keep their student safe!

# How to Tread Water

You have to learn to tread before you learn to swim. Here's how to keep your head above the water.

## Steps

1. **Use both your arms and legs.** Make use of all your four limbs, it can really help.
2. **Keep your head up.** The only way to breathe is through your nose or mouth, and you must breathe. If your head is below the water, you could start to panic. That could make it harder for people to save you if you're drowning.
3. **Move your arms in a horizantal way.** If you move them up and down, you'll move up, and then move down again because you have to pull them back up. Move your arms forward and back with your hands closed facing the way they are moving. This will keep your upper body up.
4. **Move your legs in a circular way** or **kick your legs.** If you are moving your legs in a circular fashion, don't point your feet and keep them stiff. Move your legs . If you are kicking, point your feet and kick fast and constantly. I recommend the egg beater way.

## Tips

- If you need to, use floatation devices. They can get you used to floating in the water.
- Exersising will make it easier to hold your body weight up in water.
- The more salt or sugar in the water, the easier it is to float.

## Warnings

- If your new at swimming, don't try to impress somebody in the water (like treading water without arms, without legs, etc.).
- Always swim with a buddy

# How to Tread Water Eggbeater Style

This is a method of treading water used by water polo players that allows a person to get much more of their body out of the water than any other method.

## Steps

1. Get in a pool and position yourself vertically in the water.
2. Start breaststroke (frog style) kicking to stay afloat, but only kick one leg at a time.
3. At the same time keep your arms in front of you about shoulder width apart moving back and forth to keep you balanced and to help keep you afloat.
4. Spread your legs as far as you comfortably can (like doing the splits) and kick each leg somewhat circularly, bringing each leg straight out then back up to your thigh pulling the water underneath your body.
5. It may take some time learning to keep your hips stable while doing this, so focus on that or have someone hold your hips in place.

## Tips

- Your feet will be acting like wings under water and the water under your foot will be going faster than the water on the top of your foot which will provide the lift that keeps you up.
- It helps to position your hips slightly behind your shoulders

## Warnings

- When you first learn this it can be tiring, but after doing it for a couple of days you get used to it and it becomes highly effective. If you are just learning it do not try to stay in very deep water for too long!

# Wrestling

## How to Be a Better Wrestler

Here are the key components to being successful in the dificult sport of wrestling.

### Steps

1. Condition to the point where you never pause to catch your breath. You must be intense the entire time you are competing.
2. Have at least 4 or 5 moves from each position that you can depend on at any time (bank on moves). These are your foundation and must be drilled to the point that even if your opponent knows what you are going to do, he cannot stop you.
3. Know the basic counters to each of your bank on moves, so you know what to expect.
4. Work on a perfect stand-up first; you can never win a match from the bottom position.
5. Write down every move you learn, and review the list daily. Any time you hesitate in a wrestling match, you have created an opportunity for your opponent. Be loyal to your bank on moves; they will get you started and get you through the difficult times.
6. Remember that everyone has experienced frustration at some point during training. Don't let it consume you.
7. Realize that the adage "practice makes perfect" is not quite true. In fact, **perfect** practice makes perfect. If you get sloppy in practice, this will lead to sloppy performance.

### Tips

- Set a reachable goal each week. Some people have high expectations in the beginning, and when these are not accomplished, they get frustrated. It may take three months to get your hand raised for three seconds, but those three seconds are your testament to how hard you have worked. This is a tough sport, never forget that.
- Some wrestlers try to learn too much in the beginning; quality is always better than quantity.
- Just because a move works for someone else, this does not mean that it is best suited for you. The move has to work for you and you need to have confidence in it.

## Warnings

- Eat healthy and stay in your weight class.
- Don't ruin your investment by not following a code of good ethics. It is such a disappointment when an athlete is affected by negative peer pressure. All of your hard work can be lost due to a moment of poor judgement.

# How to Become a Pro Wrestler

While many people dismiss professional wrestling as a hoax, a scam, or just plain "fake", there is a lot to learn about wrestlers and what you need to go through to become one of the monsters you see on TV on Monday night. This guide will show a short-version of what needs to be done to make it big in today's world.

## Steps

### Get your head in the game

Wrestling as a business is an equally physical, mental, and social passtime. Before breaking into the business, you should follow the following path.

1. Understand that wrestling is not "fake".
    - Wrestling isn't fake, it's predetermined. There is no way to fake falling down, or getting hit in the head with a metal object. While it can be obvious that wrestlers are not trying to hurt each other, sometimes things get out of hand or people make mistakes.
    - Many people go into training thinking that they will never get hurt, but the reality is that you **will** get hurt. It's just a matter of time.
2. Watch wrestling.
    - The more you watch, the more you learn. Even the most seasoned veterans watch tapes of wrestling matches to learn how their opponents work and to get new ideas.
3. Learn to fight.
    - Knowing what it takes to win a real fight can make your future wrestling matches more realistic.
    - As stated above, sometimes things get out of hand and your only option will be to fight back.
4. Get in shape.

    - Wrestling is an extremely athletic activity. While you don't need the body of a world class athlete, you must have strong cardio to prevent "blowing up" early into your matches.
5. Forget your "gimmick".
    - Once you learn the basics and mechanics of a wrestling match, you can begin to develop a character. Remember that promotors may refuse to hire you for any reason, including your inability to portray a different character than the one you created for yourself.

### Get trained

Now that you've gotten the correct mindset, get some professional help from an experienced trainer.

1. Shop around.
    - Most independent promotions have several wrestlers that are willing to train new wrestlers, but this training will most likely not come for free. It is not uncommon for wrestling camps to charge upwards of $100 per training session, but there are also cases where veterans pick up rookies for no cost as a way for them to polish their own skills.
    - Travel your state and find a wrestler that fits the style you want to wrestle in. Try to talk to the promotor of the company and let him/her know that you are interested in becoming a wrestler. **Some promotors are nicer than others.** While pro-wrestling can seem to be just like any other community-theatre, many "insiders" are not fond of letting new people into the business.
        - If you are rejected, take it in stride. Continue coming to shows or perhaps ask to help with the technical aspects of running the show or working on the security team. As wrestlers and promoters get to know you, they will be more open to talking and allowing you to train.
2. Be respectful
    - Your trainer and all other wrestlers have gone through everything you are. Listen to them and learn from their experiences.

## Tips

- Never stop watching wrestling from both a wrestler's perspective and a fan's perspective. It is common for wrestlers to "call out" moves or sets of moves simply by the name of the person who created that spot. If you don't know the history of the business well enough, you may miss out on some of these important communications.

- Prepare to play the game. Wrestling is extremely political, be prepared to play with the big boys.
- Use two ears and one mouth

# How to Chokeslam an Opponent Like Kane

It's a little hardcore. But its better than Big Shows it looks a little more realistic and painful. Bear with me!

## Steps

1. Grab your opponent by the neck. But don't actually choke them! Just grasp right under there jaw-bone hard enough to keep your grip.
2. With your other arm, flip there arm onto your arm which is holding there neck. Remember wrestling isn't all real they put there arm like that so the opponent can help them grip them.
3. Heres the hard part. With the arm thats holding them, pick them up high enough so that there shoulders are up to your head, and then slam them onto the ground. It is better to release your hold when there back is at least 5 inches away from the ground, so it makes a bigger impact sound and also so you don't fall with them.
4. Gongrats! If you want to, taunt them. But keep your words soft and sweet, in case you have to eat them later!

## Tips

- Well its obvious, but you need to exercise your arms ALOT! Kane's chokeslam uses only one arm to pick up the opponent so its quite the accomplishment to do this stunt.
- Use your dominant arm. If you don't, good luck trying to pic them up.
- Practice. ALOT.
- NEVER TRY with a taller, more heavier person! Chances are with a heavier person is you won't be able to pick them up. With a taller person, you probably couldn't even reach there throat! Be reasonable with your abilities. Don't try something you can't do!

## Warnings

- As with any other wrestling move, BE CAREFUL! Any move could end up being a disaster whether it's an impressive Military Press, or a simple suplex. Do the moves on a flat surface, preferably an exercise mat or an actual ring. Don't be the manly man and try this like off a roof or on a hill because if something goes wrong, your going to look like an idiot. Believe me.
- NEVER ATTEMPT TO ACTUALLY CHOKE THE OPPONENT!!! That could lead to a serious problem and would make you look like an even BIGGER idiot.

## Things You'll Need

- Strong arms
- An flat, even surface (preferably an exercise mat or an actual wrestling ring)
- An opponent

# How to Condition to Lose Weight Before Wrestling Match

Wrestling is a very tough sport. It requires, in order of importance: endurance, intelligence, technique and power. One major aspect is the weight class. This is how to lose weight. It works most of the time, especially with proper diet and sleep. Do this with a partner or a team to keep you motivated.

## Steps

1. Start out with a mile warmup lap. Run slowly (faster than a jog) to get your heart beating.
2. Come onto the mat and warm up your hips with some cycles of high crotch, double leg and single leg submission moves. Do round-ups, cartwheels, reverse rolls, suicide jumps, etc., anything to stretch out your entire body. Warming up and stretching is important to prevent injury.
3. Stretch out your hips, butterfly, roll, flip, calf. Try to gain more flexibility.
4. Do 5 sets of sixers (running back and forth to the half court of a basketball court 6 times counts as one set) while your partner does pushups. Switch back and forth during the 5 sets.
5. Run a stadium size bleacher after a 3-minute break. You don't have to sprint, just keep your heart beating and your hips in motion.
6. Get out the jumping ropes and do a ladder of 30 seconds, 1 minute, 1.5 minutes, 2 minutes, 2.5 minutes, 3 minutes, 2.5 minutes, 2 minutes, 1.5 minutes, 1 minute and 30 minutes. Do as many jump rope cycles as possible.

7. Do 25 curl-ups, 25 crunches, 25 wide hand pushups, and 25 closed hand pushups while your partner does some wall sits (lean against the wall, sit down so that your hips are perpendicular with the wall. this hurts.).
8. Run another mile to "shake it off".

## Tips

- Drink as little water as possible. The more raw water in your stomach, the more often you'll find yourself catching breaths. Do drink water, but not as much. Consult your doctor.
- As stated above, find a partner and alternate exercises. It's fun, competitive and you feel good if your partner is struggling and you're not. Vice versa. It's also extra insurance, in case one of you passes out.
- Drink more water afterwards. Eat a nutritious meal and don't go lie down right away. Allow time for the muscles to relax.
- In other variations, usually the activity that burns fat is the one that is aerobic, getting the heart beating and when your heart is at a certain rate, you start burning fat. Each person has a specific rate. Run a lot and you have a high chance at burning fat.
- Diet: avoid carbohydrates (noodles, pasta, bread, rice). instead, eat vegetables, salads, and if you're a righteous carnivore, grill a skinless chicken breast and enjoy it w/ a salad.

## Warnings

- Ask your physician if you're in shape to follow these instructions or if your body will be more productive at a different program.
- Do *not* over-exercise. There's only so much your body can take. After a while of intense training you'll experience muscle pain. Again, ask your doctor if muscles aren't the only thing that hurt.
- These exercises are most effective if you do them repeatedly. Doesn't work that well if you only follow them for two days and then just quit.

## Things You'll Need

- Jumping ropes
- Good running shoes
- Two cups of water, maximum

- Partner(s) that can help you in case of emergency
- Mental preparedness. Try saying to yourself "Don't quit, you're almost there" or imagine a reward if you complete these exercises (salad and a good shower).
- A scale, to check your progess
- A good attitude

# How to Do a 619 Like Rey Mysterio

So you want to be like Rey and do one of the best looking special moves? Read on.

## Steps

1. Beat your opponent until they are in a weakened state. This is so they don't reverse your attack.
2. Do any move possible that throws or places them onto the middle rope. Both of the opponents arms need to be resting over on the other side of the rope.
3. Run to the opposite side of the ring and bounce off the ropes for added speed.
4. Run full speed at either the left or right of the opponent.
5. Grab both the top rope and middle rope with either hand. At the same time your doing that, jump between the two your holding. This should create a slingshot effect (i.e. the ropes your holding pull back and propel you towards thier head).
6. Tuck your legs in so that the only thing hitting thier head is your knee. You dont want to hit them with your leg or thigh so try to aim your knee at the same time your in mid-air.
7. Heres the awesome part. Let your knee hit there head, unfold your tucked in legs, and land on the outside edge of the platform. Now you can go in two different directions form here:
8. The Regular Way: Just go back in the ring and pin them down. Easy.
9. The Pin-Down Way (Hard): Jump up from the outside edge onto the top-rope and keep yourself balanced until the opponent woozily stands up. Read the next step to figure out the rest.
10. As he stands up, wait until they face you then jump toward them. If aimed right, put there head between your legs. Now you can go ANOTHER two ways from here:
11. The Easy Way: Just let them fall back so your bodies wieght will go onto their head. A devastating move!
12. The Westcoast Pop Lock (hard!): Read the next step!
13. Now to do the WCPL you need to be fast. REALLY fast. Because if your to slow, they'll either collapse from your wieght or fall backwards, either one you don't want.
14. So anyhoo, now your on top of thier head and you need to figure out whats next. Just fall back and grab either thier left or right leg, whichever you feel is better to grab. Then pull that leg and your body up, so that they have only one leg to balance all that wieght on. This will send them falling back. Onward to the next step.

15. Now there on the floor and you still are grabbing there leg. What now? Easy. Just do a leg pin. The opponent is to woozy to even get up now so your match is over. Nice job if you got this far!

## Tips

- Be very quick! Too slow and the whole process could collapse.
- PRACTICE! This probably won't come to you the first time if you do the entire thing, including the WCPL.
- Don't make them too tired, or they will not get up for your WCPL.

## Warnings

- BE CAREFUL! Anything could happen to either you or the opponent!! Especially when your knee hits there face! You could knock them in the eye and make them lose it or your knee could give out which would cause YOU to fall over at the edge.
- When doing the easy headslam (When you dont want to do the WCPL) also be very careful! If your WAY to heavy (i.e. your a 225 pound man putting all your wieght on a 150 pound man) don't even try to do this.
- Remember, its not about killing your opponent. Its partly about looking good. You can give your opponent 5 bad 619's and knock your opponent out. Or you can fake one good 619 and get all your observers eyes. DONT HURT WHOEVER YOU ARE DOING IT TO

# How to Do a Wrestling Powerbomb

Powerbomb is a very common and popular move in wrestling. It is used by almost all wrestlers and attempted by fans. This move takes a lot of strength and power to perform.

## Steps

1. Stand up straight, have your opponent's head in between thighs, and bend your thighs a little. Make sure you are comfortable and so is your opponent.
2. Place your hands on your opponent's stomach.
3. Pull your opponent up with all of your might. Your opponent must flip himself when pulling so he can get up to your shoulders.
4. Your opponent should be up to your shoulders with this stomach to your head. Drop them with force.

## Tips

- Take it slow and easy. This takes a lot of strength and power, work out. Do it on soft ground eg. trampoline, bed or a real wrestling ring.

## Warnings

- Muscle strains may occur. Broken necks or back if done on hard ground.

# How to Do an Arm Bar

Here are two ways to do an arm lock, a crucial move in wrestling.

## Steps

### Arm lock one:

1. Place your left arm between his right (your left) arm and body.
2. Put your arm over his and in front of his head.
3. Twist him towards your body.

### Arm lock two:

1. Have the back of his hand facing towards you with your left hand underneath, and your right hand on top touching each other.
2. Have your left thumb touching your right thumb.
3. Twist his arm so his elbow is facing towards the sky.
4. With your left elbow, put pressure on his elbow, and pull his hand up. Don't do it too hard, otherwise you'll break his arm!

## Warnings

- Do not pull or push too hard, or you may cause an injury

# How to Lose Weight Wrestling

This is for wrestling and fighting purposes only.

## Steps

1. Lower body fat percentage by eating healthy 1 month prior to competition.
2. Begin cutting water weight 1-2 days before your competition. Remember that this weight is only a temporary loss, so don't start too early or you'll over dehydrate yourself.
3. Slap on a sauna suit, and run until you can't stand anymore. If you feel like stopping, convince yourself you're not cool. NOTE: MOST HIGH SCHOOLS DO NOT ALLOW THIS. you will be DQed if you do this.
4. Try bringing along a friend to encourage you/save you from dying.
5. Upon weighing in, restore your electrolytes, by drinking small amounts of Gatorade, slowly (ginger ale is also tasty). You know you are hydrated when you have to urinate, for the second time.
6. Dominate those in a lower weight class.

## Tips

- Don't eat or drink during water weight cutting. If you are STARVING and must eat something, eat granola in small amounts. It is dry, so it weighs very little.
- Spend the extra few bucks on a quality sauna suit.

## Warnings

- During cutting you're easily aggravated.
- Don't over-do it; you could die.
- Don't use laxatives.
- Do not let your girlfriend see you in this condition, she won't approve.
- Your penis size will decrease during this time period; it will return fully functional after you're hydrated.
- Sex drive decreases.

# How to Perform a Pedigree Like WWE Star Triple H

A pedigree is a wrestling move most famous by the WWE superstar Triple H. This is an excellent way to win any fight.

## Steps

1. Kick our oponent in the stomach or some way make them into a hunched over position. The back should be at around a 70 degree angle.
2. Put their arms behind their back. This is the key part of the move.
3. Put your arms under their arms and place your hand flat on their back.
4. After doing this, push their head down so it goes in between your legs.
5. Now here's the fun part. While pushing on their back, jump and and on your knees.
6. Congratulations! You have just pedigreed a person!

## Tips

- To avoid injury among yourself, when pushing on your oponents back and jumping on your knees, try to jump away from your oponent and let your hands free, making this face-buster tactic a complete sucess.
- Make sure the person can get their hands in front of their face first. I took a pedigree from my little brother on a wooden floor and got concussed. meh

## Warnings

- Make sure the person is worn out first. The easiest way to counter a pedigree is by a spear (or tackle).
- You can modify a pedigree so instead of your oponent landing on their face, they land on their neck. Just be caution about injury to the face or neck when performing this stunt.
- **Do not** put pressure on your opponents neck when his head in between his legs! This is not a submission move.

# How to Win a Grapple Easily

If you do end up having to defend yourself in a fight (or in a wrestling match), grappling is a good way of getting your opponent into a vulnerable position on the ground. Follow these steps and you'll have a better chance of coming out on top.

## Steps

1. If the person is bigger than you, use a kind of rugby tackle to take him. Don't try to use headlocks or armlocks unless you are familiar with them. Aim to pull your opponent's legs away from him. If he doesn't have legs to stand on, he can't stand, can he?
2. Once you have your opponent on the ground (assuming you are on your feet), either run or kick him in the upper body and chest.
3. If you have fallen to the ground on top of the opponent, and you don't want to risk trying to get up, put your full body weight on your opponent's shoulders. This makes it harder for him to get to his feet. If you are on hard ground such as concrete or wood, hit his head back into it -- not too hard though, as there is a risk of death.

## Tips

- If you are fighting more than one opponent, pick one and concentrate on him first, then pick another and so on.
- If you happen to find yourself on the ground during a fight, cover your head with your hands and kick out with your feet until you get an opportunity to get to your feet
- If you *really* want to win the fight- ignore all of the above and learn Brazilian Jiu Jitsu. Grappling is for one on one confrontations ONLY. If you try to grapple in a fight with many opponents you will get stomped on.

## Warnings

- Don't fight unless you have to.
- This article will get you beaten very badly in a real fight. If you place all of your weight on the opponent's shoulders, it will be easy for them to roll you over them because your weight is not equally distributed.
- Also note that trying to take a slightly experienced wrestler or grappler to the ground in the manner described by the author will result in them gaining control of the situation and putting you in a very vulnerable position.

- Taking a wrestler or grappler, with minimal experience, to the ground in a fight is probably the worst move you could attempt to make. If you're not more experienced than your opponent on the ground, don't attempt to take them there. For that matter, just walk away if possible.

# Nutrition


The updated USDA food pyramid, is a general nutrition guide for recommended food consumption.

**Nutrition** science studies the relationship between diet and states of health and disease. Dieticians are Health professionals who are specialized in this area of expertise, highly trained to provide safe, evidence-based dietary advice and interventions.

Between the extremes of optimal health and death from starvation or malnutrition, there is an array of disease states that can be caused or alleviated by changes in diet. Deficiencies, excesses and imbalances in diet can produce negative impacts on health, which may lead to diseases such as scurvy, obesity or osteoporosis, as well as psychological and behavioral problems. Moreover, excessive ingestion of elements that have no apparent role in health, (e.g. lead, mercury, PCBs, dioxins), may incur toxic and potentially lethal effects, depending on the dose. The science of nutrition attempts to understand how and why specific dietary aspects influence health.

## Overview

Nutrition science seeks to explain metabolic and physiological responses of the body to diet. With advances in molecular biology, biochemistry, and genetics, nutrition science is additionally developing into the study of integrative metabolism, which seeks to connect diet and health through the lens of biochemical processes.

The human body is made up of chemical compounds such as water, amino acids (proteins), fatty acids (lipids), nucleic acids (DNA/RNA), and carbohydrates (e.g. sugars and fiber). These compounds in turn consist of elements such as carbon, hydrogen, oxygen, nitrogen, and phosphorus, and may or may not contain minerals such as calcium, iron, or zinc. Minerals ubiquitously occur in the form of salts and electrolytes. All of these chemical compounds and elements occur in various forms and combinations (e.g. hormones/vitamins, phospholipids, hydroxyapatite), both in the human body and in organisms (e.g. plants, animals) that humans eat.

The human body necessarily comprises the elements that it eats and absorbs into the bloodstream. The digestive system, except in the unborn fetus, participates in the first step which makes the different chemical compounds and elements in food available for the trillions of cells of the body. In the digestive process of an average adult, about seven litres of liquid, known as digestive juices, exit the internal body and enter the lumen of the digestive tract. The digestive juices help break chemical bonds between ingested compounds as well as modulate the conformation and/or energetic state of the compounds/elements. However, many compounds/elements are absorbed into the bloodstream unchanged, though the digestive process helps to release them from the matrix of the foods where they occur. Any unabsorbed matter is excreted in the feces. But only a minimal amount of digestive juice is eliminated by this process; the intestines reabsorb most of it; otherwise the body would rapidly dehydrate; (hence the devastating effects of persistent diarrhea).

Study in this field must take carefully into account the state of the body before ingestion and after digestion as well as the chemical composition of the food and the waste. Comparing the waste to the food can determine the specific types of compounds and elements absorbed by the body. The effect that the absorbed matter has on the body can be determined by finding the difference between the pre-ingestion state and the post-digestion state. The effect may only be discernible after an extended period of time in which all food and ingestion must be exactly regulated and all waste must be analyzed. The number of variables (e.g. 'confounding factors') involved in this type of experimentation is very high. This makes scientifically valid nutritional study very time-consuming and expensive, and explains why a proper science of human nutrition is rather new.

In general, eating a variety of fresh, whole (unprocessed) foods has proven hormonally and metabolically favourable compared to eating a monotonous diet based on processed foods. In particular, natural, whole foods provide higher amounts and a more favourable balance of essential and vital nutrients per unit of energy, resulting in better management of cell growth, maintenance, and mitosis (cell division) as well as regulation of appetite and energy balance. A generally more regular eating pattern (e.g. eating medium-sized meals every 3 to 4 hours) has also proven more hormonally and metabolically favourable than infrequent, haphazard food intake.

# History

Humans are believed by scientists to have evolved as omnivorous hunter-gatherers over the past 250,000 years. Early diets were primarily vegetarian with infrequent game meats and fish where available.

Agriculture developed about 10,000 years ago in multiple locations throughout the world, providing grains such as wheat, rice, and maize, with staples such as bread and pasta. Farming also provided milk and dairy products, and sharply increased the availability of meats and the diversity of vegetables. The importance of food purity was recognized when bulk storage led to infestation and contamination risks. Cooking developed as a ritualistic activity due to efficiency and reliability concerns requiring adherence to strict recipes and procedures, and in response to demands for food purity and consistency.

## Antiquity through Enlightenment

- c. 475 BC: Anaxagoras states that food is absorbed by the human body and therefore contained "homeomerics" (generative components), thereby deducing the existence of nutrients.
- c. 400 BC: Hippocrates says, "Let food be your medicine and medicine be your food."
- The first recorded nutritional experiment is found in the Bible's Book of Daniel. Daniel and his friends were captured by the king of Babylon during an invasion of Israel. Selected as court servants, they were to share in the king's fine foods and wine. But they objected, preferring vegetables (pulses) and water in accordance with their Jewish dietary restrictions. The king's chief steward reluctantly agreed to a trial. Daniel and his friends received their diet for 10 days and were then compared to the king’s men. Appearing healthier, they were allowed to continue with their diet.
- 1500s: Scientist and artist Leonardo da Vinci compared metabolism to a burning candle.

- 1747: Dr. James Lind, a physician in the British navy, performed the first scientific nutrition experiment, discovering that lime juice saved sailors who had been at sea for years from scurvy, a deadly and painful bleeding disorder. The discovery was ignored for forty years, after which British sailors became known as "limeys." The essential vitamin C within lime juice would not be recognized by scientists until the 1930s.
- 1770: Antoine Lavoisier, the "Father of Nutrition and Chemistry" discovered the details of metabolism, demonstrating that the oxidation of food is the source of body heat.
- 1790: George Fordyce recognized calcium necessary for fowl survival.

## Modern era through 1941

- Early 1800s: The elements carbon, nitrogen, hydrogen and oxygen were recognized as the primary components of food, and methods to measure their proportions were developed.
- 1816: François Magendie discovers that dogs fed only carbohydrates and fat lost their body protein and died in a few weeks, but dogs also fed protein survived, identifying protein as an essential dietary component.
- 1840: Justus Liebig discovers the chemical makeup of carbohydrates (sugars), fats (fatty acids) and proteins (amino acids.)
- 1860s: Claude Bernard discovers that body fat can be synthesised from carbohydrate and protein, showing that the energy in blood glucose can be stored as fat or as glycogen.
- Early 1880s: Kanehiro Takaki observed that Japanese sailors developed beriberi (or endemic neuritis, a disease causing heart problems and paralysis) but British sailors did not. Adding milk and meat to Japanese diets prevented the disease.
- 1896: Baumann observed iodine in thyroid glands.
- 1897: Christiaan Eijkman worked with natives of Java, who also suffered from beriberi. Eijkman observed that chickens fed the native diet of white rice developed the symptoms of beriberi, but remained healthy when fed unprocessed brown rice with the outer bran intact. Eijkman cured the natives by feeding them brown rice, discovering that food can cure disease. Over two decades later, nutritionists learned that the outer rice bran contains vitamin B1, also known as thiamine.
- Early 1900s: Carl Von Voit and Max Rubner independently measure caloric energy expenditure in different species of animals, applying principles of physics in nutrition.
- 1906: Wilcock and Hopkins showed that the amino acid tryptophan was necessary for the survival of mice. Gowland Hopkins recognized "accessory food factors" other than calories, protein and minerals, as organic materials essential to health but which the body cannot synthesise.
- 1907: Stephen M. Babcock conducts the Single-grain experiment.
- 1912: Casmir Funk coined the term vitamin, a vital factor in the diet, from the words "vital" and "amine," because these unknown substances preventing scurvy, beriberi, and pellagra, were thought then to be derived from ammonia.

- 1913: Elmer V. McCollum discovered the first vitamins, fat soluble vitamin A, and water soluble vitamin B (in 1915; now known to be a complex of several water-soluble vitamins) and names vitamin C as the then-unknown substance preventing scurvy.
- 1919: Sir Edward Mellanby incorrectly identified rickets as a vitamin A deficiency, because he could cure it in dogs with cod liver oil.
- 1922: McCollum destroys the vitamin A in cod liver oil but finds it still cures rickets, naming vitamin D
- 1922: H.M. Evans and L.S. Bishop discover vitamin E as essential for rat pregnancy, originally calling it "food factor X" until 1925.
- 1925: Hart discovers trace amounts of copper are necessary for iron absorption.
- 1927: Adolf Otto Reinhold Windaus synthesizes vitamin D, for which he won the Nobel Prize in Chemistry in 1928.
- 1928: Albert Szent-Gyorgyi isolates ascorbic acid, and in 1932 proves that it is vitamin C by preventing scurvy. In 1935 he synthesizes it, and in 1937 he wins a Nobel Prize for his efforts. Szent-Gyorgyi concurrently elucidates much of the citric acid cycle.
- 1930s: William Cumming Rose identifies essential amino acids, necessary proteins which the body cannot synthesize.
- 1935: Underwood and Marston independently discover the necessity of cobalt.
- 1936: Eugene Floyd Dubois shows that work and school performance are related to caloric intake.
- 1938: The chemical structure of vitamin E is discovered by Erhard Fernholz, and it is synthesised by Paul Karrer.
- 1941: The first Recommended Dietary Allowances (RDAs) were established by the National Research Council.

## Recent

- 2002 Study shows relation between nutrition and violent behavior
- 2005 Obesity may be caused by adenovirus in addition to bad nutrition

# Nutrition and Health

There are six main nutrients in which the body needs to receive. These nutrients include carbohydrates, proteins, fats, vitamins, minerals, and water. It is important to consume these six nutrients on a daily basis to build and maintain healthy body systems.

Ill health can be caused by an imbalance of nutrients, producing either an excess or deficiency, which in turn affects body functioning cumulatively. Moreover, because most nutrients are, in some way or another, involved in cell-to-cell signalling (e.g. as building block or part of a hormone or signalling 'cascades'), deficiency or excess of various nutrients affects hormonal function *indirectly*. Thus, because they largely regulate the expression of genes, hormones represent a link between nutrition and how our genes are expressed, i.e. our phenotype. The strength and nature of this link are continually under investigation, but observations especially in recent years have demonstrated a pivotal role for nutrition in hormonal activity and function and therefore in health.

One source of articles on nutrition and health is the quarterly newsletter of the Nutrition for Optimal Health Association (NOHA). Articles since 1984 are indexed by subject, name, and chronology.

## Essential and non-essential amino acids

The body requires amino acids to produce new body protein (protein retention) and to replace damaged proteins (maintenance) that are lost in the urine. In animals amino acid requirements are classified in terms of essential (an animal cannot produce them) and non-essential (the animal can produce them from other nitrogen containing compounds) amino acids. Consuming a diet that contains adequate amounts of essential (but also non-essential) amino acids is particularly important for growing animals, who have a particularly high requirement.

## Vitamins

Mineral and/or vitamin deficiency or excess may yield symptoms of diminishing health such as goitre, scurvy, osteoporosis, weak immune system, disorders of cell metabolism, certain forms of cancer, symptoms of premature aging, and poor psychological health (including eating disorders), among many others.

As of 2005, twelve vitamins and about the same number of minerals are recognized as "essential nutrients", meaning that they must be consumed and absorbed - or, in the case of vitamin D, alternatively synthesized via UVB radiation - to prevent deficiency symptoms and death. Certain vitamin-like substances found in foods, such as carnitine, have also been found essential to survival and health, but these are not strictly "essential" to eat because the body can produce them from other compounds. Moreover, thousands of different phytochemicals have recently been discovered in food (particularly in fresh vegetables), which have many known and yet to be explored properties including antioxidant activity (see below). Other essential nutrients include essential amino acids, choline and the essential fatty acids.

## Fatty acids

In addition to sufficient intake, an appropriate balance of essential fatty acids - omega-3 and omega-6 fatty acids - has been discovered to be crucial for maintaining health. Both of these unique "omega" long-chain polyunsaturated fatty acids are substrates for a class of eicosanoids known as prostaglandins which function as hormones. The omega-3 eicosapentaenoic acid (EPA) (which can be made in the body from the omega-3 essential fatty acid alpha-linolenic acid (LNA), or taken in through marine food sources), serves as building block for series 3 prostaglandins (e.g. weakly-inflammation PGE3). The omega-6 dihomo-gamma-linolenic acid (DGLA) serves as building block for series 1 prostaglandins (e.g. anti-inflammatory PGE1), whereas arachidonic acid (AA) serves as building block for series 2 prostaglandins (e.g. pro-inflammatory PGE 2). Both DGLA and AA are made from the omega-6 linoleic acid (LA) in the body, or can be taken in directly through food. An appropriately balanced intake of omega-3 and omega-6 partly determines the relative production of different prostaglandins, which partly explains the importance of omega-3/omega-6 balance for cardiovascular health. In industrialised societies, people generally consume large amounts of processed vegetable oils that have reduced amounts of essential fatty acids along with an excessive amount of omega-6 relative to omega-3.

The rate of conversions of omega-6 DGLA to AA largely determines the production of the respective prostaglandins PGE1 and PGE2. Omega-3 EPA prevents AA from being released from membranes, thereby skewing prostaglandin balance away from pro-inflammatory PGE2 made from AA toward anti-inflammatory PGE1 made from DGLA. Moreover, the conversion (desaturation) of DGLA to AA is controlled by the enzyme

delta-5-desaturase, which in turn is controlled by hormones such as insulin (up-regulation) and glucagon (down-regulation). Because different types and amounts of food eaten/absorbed affect insulin, glucagon and other hormones to varying degrees, not only the amount of omega-3 versus omega-6 eaten but also the general composition of the diet therefore determine health implications in relation to essential fatty acids, inflammation (e.g. immune function) and mitosis (i.e. cell division).

## Sugars

Several lines of evidence indicate lifestyle-induced hyperinsulinemia and reduced insulin function (i.e. insulin resistance) as a decisive factor in many disease states. For example, hyperinsulinemia and insulin resistance are strongly linked to chronic inflammation, which in turn is strongly linked to a variety of adverse developments such as arterial microinjuries and clot formation (i.e. heart disease) and exaggerated cell division (i.e. cancer). Hyperinsulinemia and insulin resistance (the so-called metabolic syndrome) are characterized by a combination of abdominal obesity, elevated blood sugar, elevated blood pressure, elevated blood triglycerides, and reduced HDL cholesterol. The negative impact of hyperinsulinemia on prostaglandin PGE1/PGE2 balance may be significant.

The state of obesity clearly contributes to insulin resistance, which in turn can cause type 2 diabetes. Virtually all obese and most type 2 diabetic individuals have marked insulin resistance. Although the association between overfatness and insulin resistance is clear, the exact (likely multifarious) causes of insulin resistance remain less clear. Importantly, it has been demonstrated that appropriate exercise, more regular food intake and reducing glycemic load (see below) all can reverse insulin resistance in overfat individuals (and thereby lower blood sugar levels in those who have type 2 diabetes).

Obesity can unfavourably alter hormonal and metabolic status via resistance to the hormone leptin, and a vicious cycle may occur in which insulin/leptin resistance and obesity aggravate one another. The vicious cycle is putatively fuelled by continuously high insulin/leptin stimulation and fat storage, as a result of high intake of strongly insulin/leptin stimulating foods and energy. Both insulin and leptin normally function as satiety signals to the hypothalamus in the brain; however, insulin/leptin resistance may reduce this signal and therefore allow continued overfeeding despite large body fat stores. In addition, reduced leptin signalling to the brain may reduce leptin's normal effect to maintain an appropriately high metabolic rate.

There is debate about how and to what extent different dietary factors -- e.g. intake of processed carbohydrates, total protein, fat, and carbohydrate intake, intake of saturated and trans fatty acids, and low intake of vitamins/minerals -- contribute to the development of insulin- and leptin resistance. In any case, analogous to the way modern man-made pollution may potentially overwhelm the environment's ability to maintain 'homeostasis', the recent explosive introduction of high Glycemic Index- and processed foods into the human diet may potentially overwhelm the body's ability to maintain homeostasis and health (as evidenced by the metabolic syndrome epidemic).

Antioxidants are another recent discovery. As cellular metabolism/energy production requires oxygen, potentially damaging (e.g. mutation causing) compounds known as radical oxygen species or free radicals form as a result. For normal cellular maintenance, growth, and division, these free radicals must be sufficiently neutralized by antioxidant compounds, some produced by the body with adequate precursors (glutathione, Vitamin C in most animals) and those that the body cannot produce may only be obtained through the diet through direct sources (Vitamin C in humans, Vitamin A, Vitamin K) or produced by the body from other compounds (Beta-carotene converted to Vitamin A by the body, Vitamin D synthesized from cholesterol by sunlight). Different antioxidants are now known to function in a cooperative network, e.g. vitamin C can reactivate free radical-containing glutathione or vitamin E by accepting the free radical itself, and so on. Some antioxidants are more effective than others at neutralizing different free radicals. Some cannot neutralize certain free radicals. Some cannot be present in certain areas of free radical development (Vitamin A is fat-soluble and protects fat areas, Vitamin C is water soluble and protects those areas). When interacting with a free radical, some antioxidants produce a different free radical compound that is less dangerous or more dangerous than the previous compound. Having a variety of antioxidants allows any byproducts to be safely dealt with by more efficient antioxidants in neutralizing a free radical's butterfly effect.

## Intestinal bacterial flora

Some information in this article or section has **not** been **verified** and may not be reliable. Please **check for any inaccuracies**, and modify and **cite sources** as needed.

It is now also known that the human digestion system contains a population of a range of bacteria which are essential to digestion, and which are also affected by the food we eat. The role and significance of the intestinal bacterial flora is under investigation. Both good

and bad bacteria inhabit the digestive system. It is estimated that in the Western world, most people are no longer in a homeostatic balance.It is ideal to have 80% good to 20% bad, typically differentiated by gram negative and gram positive staining, respectively; however, in western diets it is more likely to be the other way around. Consuming processed food that are low in nutrients and high in sugar will allow bad bacteria to flourish.

## Phytochemicals


Blackberries are a source of polyphenol antioxidants

A growing area of interest is the effect upon human health of trace chemicals, collectively called phytochemicals. Although technically the term refers to nutrients from edible plants, especially highly colored fruits and vegetables, they are sometimes found in animal products. Unlike the anecdotal and sometimes specious nutritional claims of medicinal herbs and compounds, the effects of phytochemicals increasingly survive rigorous testing by prominent health organizations. One of the principal classes of phytochemicals are polyphenol antioxidants, chemicals which are known to provide certain health benefits to the cardiovascular system and immune system. These chemicals are known to down-regulate the formation of reactive oxygen species, key chemicals in cardiovascular disease.

Perhaps the most rigorously tested phytochemical is zeaxanthin, a yellow-pigmented carotenoid present in many yellow and orange fruits and vegetables. Repeated studies have shown a strong correlation between ingestion of zeaxanthin and the prevention and treatment of age-related macular degeneration. Less rigorous studies have proposed a correlation between zeaxanthin intake and cataracts. A second carotenoid, lutein, has also been shown to lower the risk of contracting AMD. Both compounds have been observed to collect in the retina when ingested orally, and they serve to protect the rods and cones against the destructive effects of light.

Another caretenoid, beta-cryptoxanthin, appears to protect against chronic joint inflammatory diseases, such as arthritis. While the association between serum blood levels of beta-cryptoxanthin and substantially decreased joint disease has been established, neither a convincing mechanism for such protection nor a cause-and-effect have been rigorously studied. Similarly, a red phytochemical, lycopene, has substantial credible evidence of negative association with development of prostate cancer.

The correlations between the ingestion of some phytochemicals and the prevention of disease are, in some cases, enormous in magnitude. For example, several studies have correlated high levels of zeaxanthin intake with roughly a 50% reduction in AMD. The difficulties in demonstrating causative properties and in applying the findings to human diet, however, are similarly enormous. The standard for rigorous proof of causation in medicine is the double-blind study, a time-consuming, difficult and expensive process, especially in the case of preventative medicine. While new drugs must undergo such rigorous testing, pharmaceutical companies have a financial interest in funding rigorous testing and may recover the cost if the drug goes to market. No such commercial interest exists in studying chemicals that exist in orange juice and spinach, making funding for medical research difficult to obtain.

Even when the evidence is obtained, translating it to practical dietary advice can be difficult and counter-intuitive. Lutein, for example, occurs in many yellow and orange fruits and vegetables and protects the eyes against various diseases. However, it does not protect the eye nearly as well as zeaxanthin, and the presence of lutein in the retina will prevent zeaxanthin uptake. Additionally, evidence has shown that the lutein present in egg yolk is more readily absorbed than the lutein from vegetable sources, possibly because of fat solubility. At the most basic level, the question "should you eat eggs?" is complex to the point of dismay, including misperceptions about the health effects of cholesterol in egg yolk, and its saturated fat content.

As another example, lycopene is prevalent in tomatoes (and actually is the chemical that gives tomatoes their red color). It is more highly concentrated, however, in processed tomato products such as commercial pasta sauce, or tomato soup, than in fresh "healthy" tomatoes. Such sauces, however, tend to have high amounts of salt, sugar, other substances a person may wish or even need to avoid.

## Nutrition and sports

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Nutrition is very important for improving sports performance. Contrary to popular belief, athletes need only slightly more protein than an average person.These needs are easily met by a balanced diet, and the recommended daily servings are generous enough to meet these needs. Additional protein intake is broken-down to be used as energy or stored as fat. Excess protein or grain consumption in the absence of alkalizing mineral intake (from fruits and vegetables) leads to chonic low grade acididosis in which calcium and glutamine are leached from bone and muscle respectively to keep the blood pH steady.

Endurance, strength and sprint athletes have different needs. Many athletes may require an increased caloric intake.

Maintaining hydration during periods of physical exertion is key to good performance. While drinking too much water during activities can lead to physical discomfort, dehydration hinders an athlete’s ability. It is recommended that an athlete drink about 400-600mL 2-3 hours before activity, during exercise he or she should drink 150-350mL every 15 to 20 minutes and after exercise that he or she replace sweat loss by drinking 450-675 mL for every .5 Kg body weight loss during activity.Studies have shown that an athlete that drinks before they feel thirsty stays cooler and performs better than one who drinks on thirst cues.Additional carbohydrates and protein before, during, and after exercise increase time to exhuastion as well as speed recovery. Dosage is based on work performed, lean body mass, and environmental factors (heat)

The main fuel used by the body during exercise is carbohydrates, which is stored in muscle as glycogen- a form of sugar. During exercise, muscle glycogen reserves can be used up, especially when activities last longer than 90 min.When glycogen is not present in muscles, the muscle cells perform anaerobic respiration producing lactic acid, which is responsible for fatigue and burning sensation, and post exercise stiffness in muscles.Because the amount of glycogen stored in the body is limited, it is important for athletes to replace glycogen by consuming a diet high in carbohydrates. Meeting energy needs can help improve performance during the sport, as well as improve overall strength and endurance.

# Nutrition and longevity

## Calorie restriction

Lifespan may be somehow related to the amount of food energy consumed. A pursuit of this principle of caloric restriction followed, involving research into longevity of those who reduced their food energy intake while attempting to optimize their micronutrient intake. Perhaps not surprisingly, some people found that cutting down on food reduced their quality of life so considerably as to negate any possible advantages of lengthening their lives. However, a small set of individuals persists in the lifestyle, going so far as to monitor blood lipid levels and glucose response every few months. See Calorie Restriction Society.

Underlying this research was the hypothesis that oxidative damage was the agent which accelerated aging, and that aging was retarded when the amount of carbohydrates (and thereby insulin release) was reduced through dietary restriction.

However, recent research has produced increased longevity in animals (and shows promise for increased human longevity) through the use of insulin uptake retardation. This was done through altering an animal's metabolism to allow it to consume similar food-energy levels to other animals, but without building up fatty tissue.

This has set researchers off on a line of study which presumes that it is not low food energy consumption which increases longevity. Instead, longevity may depend on an efficient fat processing metabolism, and the consequent long term efficient functioning of our organs free from the encumbrance of accumulating fatty deposits. Thus, longevity may be related to maintained insulin sensitivity. However, several other factors including low body temperature seem to promote longevity also and it is unclear to what extent each of them contribute.

Antioxidants have recently come to the forefront of longevity studies which have included the Food and Drug Administration and Brunswick labs.

## Whole Plant Food Diet

This article or section **is not written in the formal tone expected of an encyclopedia article**.
In China "some areas have essentially no cancer or heart disease, while in other areas,

they reflect up to a 100-fold increase." (this and all quotes from The China Study, by T. Colin Campbell PhD) Coincidentally, diets in China range from entirely plant-based to heavily animal-based, depending on the location. In contrast, diseases of affluence like cancer and heart disease are common throughout the United States. Most Americans eat an animal protein based diet, with relatively few calories coming from plant foods. China's homogeneous gene pool, low rates of migration, and large localized variations in diet and disease incidence provide an ideal study basis leading to reliable data.

The research makes a good case that animal protein is "one of the most toxic agents" in our diets. Evidently, it's better for our bodies to break plant proteins down into amino acids and then piece them together slowly to form human proteins, versus quickly as when one eats animal proteins containing amino acids very closely matching our own needs. Also, "the richer the diet is in the kinds and amounts of nutrients and antioxidants provided by foods of plant origin, the lower the risk of chronic degenerative diseases."

The cover article of the November 2005 issue of National Geographic is titled The Secrets of LIVING LONGER.

The article starts out with the sentence "What if I said you could add up to ten years to your life?" It's basically a lifestyle survey of three populations ... Sardinians, Okinawans, and Adventists ("right here in America") ... who generally display longevity and "suffer a fraction of the diseases that commonly kill people in other parts of the developed world, and enjoy more healthy years of life. In sum, they offer three sets of "best practices" to emulate. The rest is up to you."

In common with all three groups is to "Eat fruits, vegetables, and whole grains."

The article noted that a NIH funded study of 34,000 Seventh-Day Adventists between 1976 and 1988 "...found that the Adventists' habit of consuming beans, soy milk, tomatoes, and other fruits lowered their risk of developing certain cancers. It also suggested that eating whole wheat bread, drinking five glasses of water a day, and, most surprisingly, consuming four servings of nuts a week reduced their risk of heart disease. And it found that not eating red meat had been helpful to avoid both cancer and heart disease." Searching "34,000 Seventh-Day Adventists" will take you to several interesting study related sites.

## The French paradox

*French paradox*

It has been discovered that people living in Southern France live longer. Even though they consume a comparable amount of saturated fats, the rate of heart disease is lower in Southern France than in North America. A number of explantions have been suggested:

- Reduced consumption of processed carbohydrate and other junk foods;
- Regular consumption of red wine; or
- Living in the South requires the body to produce less heat, allowing a slower, and therefore healthier, metabolic rate.

# Nutrition, industry and food processing

Since the Industrial Revolution some two hundred years ago, the food processing industry has invented many technologies that both help keep foods fresh longer and alter the fresh state of food as they appear in nature. Cooling is the primary technology that can help maintain freshness, whereas many more technologies have been invented to allow foods to last longer without becoming spoiled. These latter technologies include pasteurisation, autoclavation, drying, salting, and separation of various components, and all appear to alter the original nutritional contents of food. Pasteurisation and autoclavation (heating techniques) have no doubt improved the safety of many common foods, preventing epidemics of bacterial infection. But some of the (new) food processing technologies undoubtedly have downfalls as well.

Modern separation techniques such as milling, centrifugation, and pressing have enabled upconcentration of particular components of food, yielding flour, oils, juices and so on, and even separate fatty acids, amino acids, vitamins, and minerals. Inevitably, such large scale upconcentration changes the nutritional content of food, saving certain nutrients while removing others. Heating techniques may also reduce food's content of many heat-labile nutrients such as certain vitamins and phytochemicals, and possibly other yet to be discovered substances. Because of reduced nutritional value, processed foods are often 'enriched' or 'fortified' with some of the most critical nutrients (usually certain vitamins) that were lost during processing. Nonetheless, processed foods tend to have an inferior nutritional profile than do whole, fresh foods, regarding content of both sugar and high GI starches, potassium/sodium, vitamins, fibre, and of intact, unoxidized (essential) fatty acids. In addition, processed foods often contain potentially harmful substances such as oxidized fats and trans fatty acids.

A dramatic example of the effect of food processing on a population's health is the history of epidemics of beri-beri in people subsisting on polished rice. Removing the outer layer of rice by polishing it removes with it the essential vitamin thiamine, causing beri-beri. Another example is the development of scurvy among infants in the late 1800's in the United States. It turned out that the vast majority of sufferers were being fed milk that had been heat-treated (as suggested by Pasteur) to control bacterial disease. Pasteurisation was effective against bacteria, but it destroyed the vitamin C.

As mentioned, lifestyle- and obesity-related diseases are becoming increasingly prevalent all around the world. There is little doubt that the increasingly widespread application of some modern food processing technologies has contributed to this development. The food processing industry is a major part of modern economy, and as such it is influential in political decisions (e.g. nutritional recommendations, agricultural subsidising). In any known profit-driven economy, health considerations are hardly a priority; effective production of cheap foods with a long shelf-life is more the trend. In general, whole, fresh foods have a relatively short shelf-life and are less profitable to produce and sell than are more processed foods. Thus the consumer is left with the choice between more expensive but nutritionally superior whole, fresh foods, and cheap, usually nutritionally inferior processed foods. Because processed foods are often cheaper, more convenient (in both purchasing, storage, and preparation), and more available, the consumption of nutritionally inferior foods has been increasing throughout the world along with many nutrition-related health complications.

# Advice and guidance on nutrition

### Governmental policies

Most Governments provide guidance on good nutrition, and some also impose mandatory labeling requirements upon processed food manufacturers to assist consumers in complying with such guidance. Current dietary guidelines in the United States are presented in the concept of a food pyramid. There is no apparent consistency in science-based nutritional recommendations between countries, indicating the role of politics as well as cultural bias in research emphasis and interpretation.

### Teaching

Nutrition is taught in schools in many countries. In England and Wales the Personal and Social Education and Food Technology curriculums nutrition included, stressing the importance of a balanced diet and teaching how to read nutrition labels on packaging. But in developing countries, it is a distant dream; misconceptions, gender bias, un awareness about hygienic conditions etc.are still existing in their full strength.

# Diet (nutrition)

In nutrition, the **diet** is the sum of the food consumed by a person or other organism. **Dietary habits** are the habitual decisions an individual or culture makes when choosing what foods to eat.

Although humans are omnivores, each culture holds some food preferences and some food taboos. Individual dietary choices may be more or less healthy. Proper nutrition requires vitamins, minerals, and fuel in the form of carbohydrates, proteins, and fats. Dietary habits play a significant role in the health and mortality of all humans. Dietary choices can also define cultures and play a role in religion.

## Cultural dietary choices

Some cultures and religions have restrictions concerning what foods are acceptable in a diet. For example, only Kosher foods are permitted by Judaism, and Halal/Haram foods by Islam, in the diet of believers. In addition, the dietary choices of different countries or regions have different characteristics. For instance, Americans eat more red meat than

people in most other countries, and Japanese eat more fish and rice. Rice and beans are typical parts of a diet in Latin-American countries, while lentils and pita bread are typical in the Middle East. This is highly related to a culture's cuisine.

Concerns about foodborne illness have long influenced diet. Traditionally humans have learned to avoid foods that induce acute illness. Some believe that this is the underlying rationale behind some traditional religious dietary requirements.

# Individual dietary choices

Many individuals choose to limit what foods they eat for reasons of health, morality, or other factors. Additionally, many people choose to forgo food from animal sources to varying degrees; see vegetarianism, veganism, fruitarianism, living foods diet, and raw foodism.

The nutrient content of diets in industrialised countries contain more animal fat, sugar, energy, alcohol and less dietary fiber, carbohydrates and antioxidants. Contemporary changes to work, family and exercise patterns, together with concerns about the effect of nutrition and overeating on human health and mortality are all having an effect on traditional eating habits. Physicians and alternative medicine practitioners may recommend changes to diet as part of their recommendations for treatment.

More recently, dietary habits have been influenced by the concerns that some people have about possible impacts on health or the environment from genetically modified food. Further concerns about the impact of industrial farming on animal welfare, human health and the environment are also having an effect on contemporary human dietary habits. This has led to the emergence of a counterculture with a preference for organic and local food.

# Diets for weight management

*Dieting*

A particular diet may be chosen to seek weight gain, weight loss, sports training, cardio-vascular health, avoidance of cancers, food allergies and for other reasons. Changing a subject's dietary intake, or "going on a diet", can change the energy balance and increase or decrease the amount of fat stored by the body. Some foods are specifically

recommended, or even altered, for conformity to the requirements of a particular diet. Foods intended to help produce weight loss are frequently labeled "diet foods". These diets are often recommended in conjuction with exercise.

## Dietary health

Imbalances between the consumed fuels and expended energy results in either starvation or excessive reserves of adipose tissue, known as body fat. Poor intake of various vitamins and minerals can lead to diseases which can have far-reaching effects on health. For instance, 30% of the world's population either has, or is at risk for developing, Iodine deficiency. It is estimated that at least 3 million children are blind due to vitamin A deficiency. Vitamin C deficiency results in scurvy. Calcium, Vitamin D and Phosphorus are inter-related; the consumption of each may affect the absorption of the others. Kwashiorkor and marasmus are childhood disorders caused by lack of dietary protein. Obesity, a serious problem in the western world, leads to higher chances of developing heart disease, diabetes, and many other diseases.

Eating disorders are a group of mental disorders that interfere with normal food consumption. They often affect people with a negative body image.

# Dietary supplement

A prescribed **dietary supplement** is intended to supply nutrients (vitamins, minerals, fatty acids or amino acids) that are missing or not consumed in sufficient quantity in a person's diet. This may include **herbal supplements** which have a history of claims that they cure or prevent certain diseases. The medical utility and regulatory status of dietary supplements is controversial.

# Retinol

**Retinol**, the dietary form of **vitamin A**, is a yellow fat-soluble, antioxidant vitamin important in vision and bone growth. It belongs to the family of chemical compounds known as retinoids. Retinol is ingested in a precursor form; animal sources (milk and eggs) contain retinyl esters, whereas plants (carrots, spinach) contain pro-vitamin A carotenoids. Hydrolysis of retinyl esters results in retinol while pro-vitamin A carotenoids can be cleaved to produce retinal. Retinal, also known as retinaldehyde, can be reversibly reduced to produce retinol or it can be irreversibly oxidized to produce retinoic acid. The best described active retinoid metabolites are 11-*cis*-retinal and the all-trans and 9-cis-isomers of retinoic acid.

| *Vitamin A (Retinol)* | |
|---|---|
| **General** | |
| Chemical formula | $C_{20}H_{30}O$ |
| Molecular weight | 286.456 g/mol |
| **Vitamin properties** | |
| Solubility | Fat |
| RDA (adult male) | 900 µg/day |
| RDA (adult female) | 700 µg/day |
| RDA upper limit (adult male) | 3,000 µg/day |
| RDA upper limit (adult female) | 3,000 µg/day |
| **Deficiency symptoms** | |
| • Night blindness<br>• Keratomalacia<br>• Pale, dry skin | |
| **Excess symptoms** | |
| • Liver toxicity<br>• Dry skin<br>• Hair loss<br>• Teratological effects<br>• Osteoporosis (suspected, long-term) | |
| **Common sources** | |
| • Liver<br>• Dairy products<br>• Darkly colored fruits<br>• Leafy vegetables | |

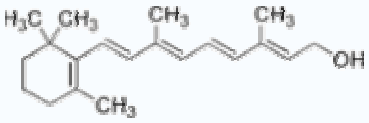
## Discovery

In 1913, Elmer McCollum, a biochemist at the University of Wisconsin-Madison, and colleague Marguerite Davis identified a fat-soluble nutrient in butterfat and cod liver oil. Their work confirmed that of Thomas Osborne and Lafayette Mendel, at Yale, which suggested a fat-soluble nutrient in butterfat, also in 1913 . Vitamin A was first synthesized in 1947.

# Chemical structure and function

Many different geometric isomers of retinol, retinal and retinoic acid are possible as a result of either a *trans* or *cis* configuration of the four double bonds found in the polyene

chain. The *cis* isomers are less stable and can readily convert to the all-*trans* configuration (as seen in the structure of all-*trans*-retinol shown here). Nevertheless, some *cis* isomers are found naturally and carry out essential functions. For example, the 11-*cis*-retinal isomer is the chromophore of rhodopsin, the vertebrate photoreceptor molecule. Rhodopsin is comprised of the 11-cis-retinal covalently linked via a Schiff base to the opsin protein (either rod opsin or blue, red or green cone opsins). The process of vision relies on the light-induced isomerisation of the chromophore from 11-*cis* to all-*trans* resulting in a change of the conformation and activation of the photoreceptor molecule. One of the earliest signs of vitamin A deficiency is night-blindness followed by decreased visual acuity.




As can be seen from the structure, retinol is derived from isoprene, and has an alcohol functional group. The first full synthesis route for the compound was found by David Adriaan van Dorp and Jozef Ferdinand Arens in 1947.

George Wald won the 1967 Nobel Prize in Physiology or Medicine for his work with retina pigments (also called visual pigments), which led to the understanding of the role of vitamin A in vision.

Many of the non-visual functions of vitamin A are mediated by retinoic acid, which regulates gene expression by activating intracellular retinoic acid receptors. The non-visual functions of vitamin A are essential in the immunological function, reproduction and embryonic development of vertebrates as evidenced by the impaired growth, susceptibility to infection and birth defects observed in populations receiving suboptimal vitamin A in their diet.

Retinol can also be used in the treatment of acne in a topical cream. A form of retinoic acid, all-trans retinoic acid (ATRA) is currently used as chemotherapy for acute promyelocytic leukemia, a subtype of acute myelogenous leukemia. This is because cells of this subtype of leukemia are sensitive to agonists of the retinoic acid receptors (RARs).

## Vision

Vitamin A is required in the production of rhodopsin, the visual pigment used in low light levels. This is why eating foods rich in vitamin A is said to allow you to see in the dark.

### Epithelial Cells

Vitamin A is essential for the correct functioning of epithelial cells. In Vitamin A deficiency, mucus-secreting cells are replaced by keratin producing cells, leading to xerosis.

### Glycoprotein synthesis

Glycoprotein synthesis requires adequate Vitamin A status. In severe Vitamin A deficiency, lack of glycoproteins may lead to corneal ulcers or liquefaction.

### Immune System

Vitamin A is essential to maintain intact epithelial tissues as a physical barrier to infection; it is also involved in maintaining a number of immune cell types from both the innate and acquired immune systems. These include the lymphocytes (B-cells, T-cells, and natural killer cells), as well as many myelocytes (neutrophils, macrophages, and myeloid dendritic cells).

### Formation of red blood cells (Haematopoiesis)

Vitamin A may be needed for normal haematopoiesis; deficiency causes abnormalities in iron metabolism.

### Growth

Vitamin A affects the production of human growth hormone.

## Units of measurement

When referring to dietary allowances or nutritional science, retinol is usually measured in international units (IU). IU refers to biological activity and therefore is unique to each individual compound, however 1 IU of retinol is equivalent to approximately 0.3 micrograms (300 nanograms).

## Nutrition

This vitamin plays an essential role in vision, particularly night vision, normal bone and tooth development, reproduction, and the health of skin and mucous membranes (the

mucus-secreting layer that lines body regions such as the respiratory tract). Vitamin A also acts in the body as an antioxidant, a protective chemical that may reduce the risk of certain cancers.

There are two sources of dietary vitamin A. Active forms, which are immediately available to the body are obtained from animal products. These are known as retinoids and include retinal and retinol. Precursors, also known as provitamins, which must be converted to active forms by the body, are obtained from fruits and vegetables containing yellow, orange and dark green pigments, known as carotenoids, the most well-known being beta-carotene. For this reason, amounts of vitamin A are measured in Retinal Equivalents (RE). One RE is equivalent to 0.001mg of retinal, or 0.006mg of beta-carotene, or 3.3 International Units of vitamin A.

In the intestine, vitamin A is protected from being chemically changed by vitamin E. Vitamin A is fat-soluble and can be stored in the body. Most of the vitamin A you eat is stored in the liver. When required by a particular part of the body, the liver releases some vitamin A, which is carried by the blood and delivered to the target cells and tissues.

## Dietary intake

The Dietary Reference Intake (DRI) Recommended Daily Amount (RDA) for Vitamin A for a 25-year old male is 900 micrograms/day, or 3,000 IU.

During the absorption process in the intestines, retinol is incorporated into chylomicrons as the ester form, and it is these particles that mediate transport to the liver. Liver cells (hepatocytes) store vitamin A as the ester, and when retinol is needed in other tissues, it is de-esterifed and released into the blood as the alcohol. Retinol then attaches to a serum carrier, retinol binding protein, for transport to target tissues. A binding protein inside cells, cellular retinoic acid binding protein, serves to store and move retinoic acid intracellularly. Carotenoid bioavailability ranges between 1/5 to 1/10 of retinol's. Carotenoids are better absorbed when ingested as part of a fatty meal. Also, the carotenoids in vegetables, especially those with tough cell walls (e.g. carrots), are better absorbed when these cell walls are broken up by cooking or mincing.

## Topical use

All retinoid forms of vitamin A are used in cosmetic and medical applications applied to the skin.

Retinoic acid, retinyl palmitate, isotretinoin, tretinoin and retinol are all used medicinally as a topical treatment for acne and keratosis pilaris. Isotretinoin is also used orally (under the trade names *Accutane* and *Roaccutane*), generally for severe or recalcitrant acne.

In cosmetics, vitamin A derivatives are used as so-called antiaging chemicals- vitamin A is absorbed through the skin and increases the rate of skin turnover, and gives a temporary increase in collagen giving a more youthful appearance.

## Vitamin A deficiency


Prevalence of vitamin A deficiency. Source: WHO

Vitamin A deficiency is common in developing countries but rarely seen in developed countries. Approximately 250,000 to 500,000 malnourished children in the developing world go blind each year from a deficiency of vitamin A. Night blindness is one of the first signs of vitamin A deficiency. Vitamin A deficiency contributes to blindness by making the cornea very dry and damaging the retina and cornea.

Vitamin A deficiency also diminishes the ability to fight infections. In countries where children are not immunized, infectious disease like measles have relatively higher fatality rates. As elucidated by Dr. Alfred Sommer, even mild, subclinical deficiency can also be a problem, as it may increase children's risk of developing respiratory and diarrheal infections, decrease growth rate, slow bone development, and decrease likelihood of survival from serious illness.

In addition to dietary problems, there are other causes of vitamin A deficiency. Iron deficiency can affect vitamin A uptake. Excess alcohol consumption can deplete vitamin A, and a stressed liver may be more susceptible to vitamin A toxicity. People who consume large amounts of alcohol should seek medical advice before taking vitamin A supplements.

Treatment of vitamin A deficiency can be undertaken with both oral and injectable forms, generally as vitamin A palmitate.

## Vitamin A overdose (Toxicity)

The Tolerable Upper Intake Level (UL) for vitamin A, for a 25-year old male, is 3,000 micrograms/day, or about 10,000 IU.

Too much vitamin A can be harmful or fatal, resulting in what is known as hypervitaminosis A. The body converts the dimerized form, carotene, into vitamin A as it is needed, therefore high levels of carotene are not toxic compared to the ester (animal) forms. The livers of certain animals, especially those adapted to polar environments, often contain amounts of vitamin A that would be toxic to humans. Thus, vitamin A toxicity is typically reported in arctic explorers and people taking large doses of synthetic vitamin A. The first documented death due to vitamin A poisoning was Xavier Mertz, a Swiss scientist who died in January 1913 on an Antarctic expedition that had lost its food supplies and fell to eating its sled dogs. Mertz consumed lethal amounts of vitamin A by eating the dogs' livers. Just 0.3 grams of the liver of the polar bear contains the upper intake level. If eaten in one meal, 30 to 90 grams is enough to kill a human being, or to make even sled dogs very ill.

Excess vitamin A has also been suspected to be a contributor to osteoporosis. This seems to happen at much lower doses than those required to induce acute intoxication. Only preformed vitamin A can cause these problems, because the conversion of carotenoids into vitamin A is downregulated when physiological requirements are met. An excessive uptake of carotenoids can, however, cause carotenosis.

The carotenoid beta carotene was interestingly associated with an increase in lung cancer when it was studied in a lung cancer prevention trial in male smokers. In non-smokers, the opposite effect has been noted.

Excess preformed vitamin A during early pregnancy has also been associated with a significant increase in birth defects. These defects may be severe, even life-threatening. Even twice the daily recommended amount can cause severe birth defects. The FDA currently recommends that pregnant women get their Vitamin A from foods containing beta carotene and that they should ensure that they consume no more than 5,000 IU of preformed Vitamin A (if any) per day. Although Vitamin A is necessary for fetal development, most women carry stores of Vitamin A in their fat cells, so oversupplementation should be strictly avoided.

## Good sources

Vitamin A is found naturally in many foods. Each of the following contains at least 0.15mg of Vitamin A or beta carotene per 1.75-7 oz. (50-200g):

- Sweet potatoes
- Carrots
- Collard greens
- Kale
- Pumpkin
- Spinach
- Sweet peppers
- Winter squash
- Apricots
- Cantaloupe melon
- Mango
- Liver (beef, pork, chicken, or turkey)
- Eggs
- Broccoli

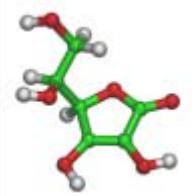
## Night vision

Night blindness - the inability to see well in dim light - is associated with a deficiency of vitamin A. This vitamin is needed for the formation of rhodopsin. This is a pigment located in the eye's retina, which is the light-sensitive tissue lining in the back of the eye.

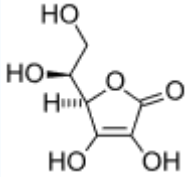
When stimulated by light, rhodopsin splits into two proteins: opsin and retinal (a form of vitamin A); when it is dark the reverse reaction occurs - the retinal and opsin combine to re-form rhodopsin, a reaction that requires extra retinal.

Without adequate amounts of retinal, regeneration of rhodopsin is incomplete and night blindness occurs. Since carrots are a good source of beta-carotene, there is truth in the old belief that carrots help you see better in the dark.

# Vitamin C



3D representation of vitamin C




Chemical structure of vitamin C

**Vitamin C** is a water-soluble nutrient and human vitamin essential for life and for maintaining optimal health, used by the body for many purposes. It is also known by the chemical name of its principal form, L-ascorbic acid. The article on ascorbic acid contains information on its chemical properties. This article describes its biological functions, discovery and the debate on how it is used by society.

## General description

Almost all animals and plants synthesize their own vitamin C. There are some exceptions, such as humans and a small number of other animals, including, apes, guinea pigs, the red-vented bulbul, a fruit-eating bat and a species of trout. This has led some scientists, including chemist Linus Pauling to hypothesize that these species either lost (or never had) the ability to produce their own Vitamin C, and that if their diets were supplemented with an amount of the nutrient proportional to the amount produced in animal species that do synthesize their own Vitamin C, better health would result. The species-specific loss in the ability to synthesize ascorbate strikingly parallels the evolutionary loss of the ability to break down uric acid. Uric acid and ascorbate are both strong reducing agents (electron-donors). This has led to the suggestion that in higher primates, uric acid has taken over some of the functions of ascorbate.

Vitamin C was first isolated in 1928, and in 1932 it was proved to be the agent which prevents scurvy. Both Charles Glen King at the University of Pittsburgh and Albert Szent-Györgyi (working with ex-Pittsburgh researcher Joseph Svirbely) came to discover what is now known as Vitamin C around April of 1932. Although Szent-Györgyi was awarded the 1937 Nobel Prize in Medicine, many feel King is as responsible for its development if not more so.

Vitamin C is a weak acid, called ascorbic acid or a salt ascorbate. It is the L-enantiomer of ascorbic acid. The D-enantiomer shows no biological activity. Both are mirror image forms of the same chemical molecular structure (see optical isomers).

The active part of the substance is the ascorbate ion, which can express itself as either an acid or a salt of ascorbate that is neutral or slightly basic. Commercial vitamin C is often a mix of ascorbic acid, sodium ascorbate and/or other ascorbates. Some supplements contain in part the D-enantiomer, which is useless and harmless. See the ascorbic acid article for a full description of the molecule's chemical properties.

# Vitamin C deficiency

No bodily organ stores ascorbate as a primary function, and so the body soon depletes itself of ascorbate if fresh supplies are not consumed through the digestive system, eventually leading to the deficiency disease known as scurvy (a form of avitaminosis), which results in illness and death if consumption of vitamin C is not resumed in time.

## Acute scurvy

Acute scurvy is characterized by:

- easy bruising, or bruising with no apparent cause
- loose teeth
- superficial bleeding
- fragility of blood vessels
- poor healing
- compromised immunity
- mild anemia

Scurvy leads to massive internal hemorrhaging, and is eventually fatal. Scurvy was a common condition among sailors at sea and during the winter season when no fresh fruits or vegetable are available.

# Functions in the body

By far the primary importance of vitamin C is as a reducing agent in the cell. Since the body of the cell is a chemically reducing environment, and the endoplasmic reticulum (ER) is oxidizing, the cell imports dehydroascorbate (oxidized vitamin C) into the ER, and exports vitamin C from the ER, maintaining the important chemical gradient.

- Oxidized vitamin C is needed for the conversion of proline to hydroxyproline, required for collagen in the connective tissue. These fibers are ubiquitous throughout the body, providing firm but flexible structure. Some tissues have a greater percentage of collagen, especially: skin, mucous membranes, teeth and bones.
- For a similar reaction, vitamin C is required for synthesis of dopamine, noradrenaline and adrenaline in the nervous system or in the adrenal glands.
- Vitamin C is also needed to synthesize carnitine, important in the transfer of fatty acids to the cell mitochondria.
- The tissues with greatest percentage of vitamin C — over 100 times the level in blood plasma — are the adrenal glands, pituitary, thymus, corpus luteum, and retina.
- The brain, spleen, lung, testicle, lymph nodes, liver, thyroid, small intestinal mucosa, leukocytes, pancreas, kidney and salivary glands usually have 10 to 50 times the concentration present in blood plasma.
- Vitamin C is an antioxidant and acts as a substrate for ascorbate peroxidase.

# Daily requirements and dose dependent effects

There is continuing debate within the scientific community over the best dose schedule (the amount and frequency of intake) of Vitamin C for maintaining optimal health in humans.

### Government agency recommended intake levels

A balanced diet without supplementation contains enough Vitamin C to prevent acute scurvy in an average healthy adult. For people who smoke, those under stress, and pregnant women it takes slightly more.

Recommendations for vitamin C intake have been set by various national agencies as follows:

40 mg per day: Food Standards Agency (UK)

60–95 mg per day, Dietary Reference Intake (DRI), Recommended Daily Allowance (RDA), U.S. Food and Nutrition Board 2004.

The U.S. Dietary Reference Intake Tolerable Upper Intake Level (UL) for a 25-year old male is 2,000 mg/day. Vitamin C is recognized to be one of the least toxic substances known to medicine. Its LD50 for rats is 11,900 mg $kg^{-1}$ , , .

## Independent dose recommendations

Multiple websites exist providing updated links to the extensive and growing literature critical of governmental agency dose recommendations. Key arguments include:

- Their study determined the peak plasma concentration of vitamin C by measuring blood plasma levels 12 hours after consumption, well after the vitamin would have been totally excreted.
- They don't take into account individual differences such as age, weight, etc. For example, heavier individuals generally need more vitamin C.
- The figures represent the amount needed to prevent the acute form of deficiency disease, while subclinical levels of the disease are not even acknowledged.
- The amount needed to prevent other diseases is not considered.
- Optimal health is not a consideration, as the level of health targeted is that which is marginally better than that which is considered malnourished.

Some researchers have calculated the amount needed for an adult human to achieve similar blood serum levels as Vitamin C synthesising mammals as follows:

> 6000-18000 mg per day – Linus Pauling's daily recommendation
> 6000-12000 mg per day – Thomas Levy, Colorado Integrative Medical Centre recommendation.
> 3000 mg per day or more during illness or pregnancy (up to 300g for some illnesses) – Vitamin C Foundation's recommendation.
> 400 mg per day – Linus Pauling Institute & US National Institutes of Health (NIH) Recommendation.
> from 3000 mg to 200,000 mg per day based on a protocol described by Robert Cathcart known as a vitamin C flush wherin escalating doses of Vitamin C are given until diarrhea develops, then choosing the highest dose that does not cause diarrhea (bowel tolerance threshold). High doses (thousands of mg) may result in diarrhea, which is harmless if the dose is reduced immediately. Some researchers claim the onset of diarrhea to be an indication of where the body's true vitamin C requirement lies. Both Cathcart and Cameron have demonstrated that very sick patients with cancer or influenza do not display any evidence of diarrhea at all until ascorbate intake reaches levels as high as 200 grams (½ pound).

However, the biological halflife for vitamin C is quite short, about 30 minutes in blood plasma, a fact which NIH and IM researchers have failed to recognize. NIH researchers established the current RDA based upon tests conducted 12 hours (24 half lives) after consumption. "To be blunt," says Hickey, "the NIH gave a dose of vitamin C, waited until it had been excreted, and then measured blood levels."

There is a strong advocacy movement for large doses of Vitamin C (see Advocacy arguments below), although not all purported benefits are supported by the medical establishment. Many pro-Vitamin C organizations promote usage levels well beyond the current Dietary Reference Intake (DRI).

## Therapeutic applications and doses

Vitamin C is needed in the diet to prevent scurvy, however, from the time it became available in pure form in the 1930s, some practitioners experimented with vitamin C as a treatment for diseases other than scurvy.

### Colds

At least 29 controlled clinical trials (many double-blind and placebo-controlled) involving a total of over 11,000 participants have been conducted into vitamin C and the Common cold. These trials were reviewed in the 1990s and again recently. The trials show that vitamin C reduces the duration and severity of colds but not the frequency. The data indicate that there is a normal dose-response relationship. Vitamin C is more effective the higher the dose. The vast majority of the trials were limited to doses below 1 g/day. As doses rise, it becomes increasingly difficult to keep the trials double blind because of the obvious gastro-intestinal side effects. So, the most effective trials at doses between 2 and 10 g/day are met with skepticism. Reports from physicians have provided ample clinical confirmation.

The controlled trials and clinical experience prove that vitamin C in doses ranging from 0.1 to 2.0 g/day have a relatively small effect. The duration of colds was reduced by 7% for adults and 15% for children. The studies provide ample justification for businesses to encourage their employees to take 1 to 2 g/day during the cold season to improve workplace productivity and reduce sick days. The clinical reports provide the strongest possible evidence that vitamin C at higher doses is significantly more effective. However, the effectiveness typically comes at the price of gastro-intestinal side effects. It is easy for

physicians to minimize these side effects since they cause no lasting harm. Adult patients, however, have proven reluctant to subject themselves to gas and cramping to deliver an unknown benefit (the duration and severity of colds is highly variable so the patient never knows what he/she is warding off). It is well worth the effort of identifying the small subset of individuals who can benefit from high daily doses (>10 g/day) of vitamin C without side effects and training them to regularly take 5 g/day during cold season and to increase the dose at the onset of a cold.

The trials proved that vitamin C is more effective for children. Reports from the field confirm the observations in the trials and suggest that children are less prone to vitamin C side effects. Colds and flu are a serious problem for children. Every time a cold infects a child, its growing mind and body must divert energy from its usual business of growth and development. If the cold is followed by an opportunistic infection, such as bronchitis or ear infection, more energy must be diverted. Colds are the number one trigger for asthma. Pre-school children in daycare are nearly constantly fighting infections (5-10 per year). Chronic disease in childhood is believed to sometimes have permanent developmental consequences which can contribute to decreased life expectancy.

**Polio**

Most notable was Fred R. Klenner, a doctor in general practice in Reidsville, North Carolina. He utilized both oral and intravenous vitamin C to treat a wide range of infections and poisons. He published a paper in 1949 that described how he had seen poliomyelitis yield to vitamin C in sufficiently large doses. No controlled clinical trials have been conducted to confirm effectiveness.

**Heart disease**

Vitamin C is the main of the three ingredients in Linus Pauling's patented preventive cure for heart disease, the other two being the amino acid lysine and nicotinic acid (a form of Vitamin B3). This treatment is not supported by mainstream medical science.[*citation needed*]

**Viral diseases, and poisons**

Orthomolecular medicine and a minority of scientific opinion sees vitamin C as being a low cost and safe way to treat viral disease and to deal with a wide range of poisons.

Vitamin C has a growing reputation for being useful in the treatment of colds and flu, owing to its recommendation by prominent biochemist Linus Pauling. In the years since Pauling's popular books about vitamin C, general agreement by medical authorities about larger than RDA amounts of vitamin C in health and medicine has remained elusive. Ascorbate usage in studies of up to several grams per day, however, have been associated with decreased cold duration and severity of symptoms, possibly as a result of an antihistamine effect . The highest dose treatments, published clinical results of specific orthomolecular therapy regimes pioneered by Drs. Klenner (repeated IV treatments, 400-700+ mg/kg/day ) and Cathcart (oral use to bowel tolerance, up to ~150 grams ascorbate per day for flu), have remained experimentally unaddressed by conventional medical authorities for decades.

The Vitamin C Foundation recommends an initial usage of up to 8 grams of vitamin C every 20-30 minutes  in order to show an effect on the symptoms of a cold infection that is in progress. Most of the studies showing little or no effect employ doses of ascorbate such as 100 mg to 500 mg per day, considered "small" by vitamin C advocates. Equally importantly, the plasma half life of high dose ascorbate is approximately 30 minutes, which implies that most high dose studies have been methodologically defective and would be expected to show a minimum benefit. Clinical studies of divided dose supplementation, predicted on pharmacological grounds to be effective, have only rarely been reported in the literature. Essentially all the claims for high dose vitamin C remain to be scientifically refuted. The clinical effectiveness of large and frequent doses of vitamin C is an open scientific question.

In 2002 a meta-study into all the published research on effectiveness of ascorbic acid in the treatment of infectious disease and toxins was conducted, by Thomas Levy, Medical Director of the Colorado Integrative Medical Centre in Denver. He claimed that evidence exists for its therapeutic role in a wide range of viral infections and for the treatment of snake bites.

**Lead poisoning**

There is also evidence that Vitamin C is useful in preventing lead poisoning, possibly helping to chelate the toxic heavy metal from the body.

**Cancer**

In 2005 in vitro research by the National Institutes of Health indicated that Vitamin C administered in pharmacological concentrations (i.e. intravenous) was preferentially toxic to several strains of cancer cells. The authors noted: "These findings give plausibility to intravenous ascorbic acid in cancer treatment, and have unexpected implications for treatment of infections where $H_2O_2$ may be beneficial." This research appeared to support Linus Pauling's claims that Vitamin C can be used to fight cancer.

In 2006 the Canadian Medical Association Journal published in vivo research that demonstrated that intravenous vitamin C can subdue advanced-stage cancer.

**Cataracts**

It has been also suggested that Vitamin C might prevent the formation of cataracts.

# Other effects

## Contraindications

A Contraindication is a condition which makes an individual more likely to be harmed by a dose of Vitamin C than an average person.

- A primary concern is people with unusual or unaddressed iron overload conditions, including hemochromatosis. Vitamin C enhances iron absorption. If sufferers of iron overload conditions take gram sized doses of Vitamin C, they may worsen the iron overload due to enhanced iron absorption.

- Inadequate Glucose-6-phosphate dehydrogenase enzyme (G6PD) levels, a genetic condition, may predispose some individuals to hemolytic anemia after intake of specific oxidizing substances present in some food and drugs. This includes repeated, very large intravenous or oral dosages of vitamin C. There is a test available for G6PD deficiency . High dose Vitamin E has been proposed as a potential protective factor.

## Side-effects

- Vitamin C causes diarrhea in everyone if taken in quantities beyond a certain limit, which is variable to the individual. Cathcart has called this limit the Bowel Tolerance Limit and observed that it is higher in people with serious illness than those in good health. It ranges from 5 to 25 grams per day in healthy individuals to 300 grams per day in the seriously ill persons, such as those with AIDS and cancer. The diarrhea side-effect is harmless, though it can be inconvenient. The diarrhea will cease as soon as the dose is reduced.

- Large doses of vitamin C may cause acid indigestion (stomach upset), particularly when taken on an empty stomach. This unpleasant but harmless side-effect can be avoided by taking the vitamin along with meals, or by offsetting its acidity by taking an antacid such as baking soda or calcium carbonate (Tums)

## Effects of Overdose

Vitamin C exhibits remarkably low toxicity. For example, in the rat, the LD50 has been reported as 11900 mg kg-1. For a 70 kg human, this means that 833,000 mg of vitamin C would need to be ingested to stand a 50% chance of killing the person. However, vitamin C could not result in death when administered orally as large amounts of the vitamin cause diarrhea and are not absorbed. An extremely large amount of vitamin C would need to be rapidly injected by IV to stand any chance of killing a person. Robert Cathcart, MD, has used intravenous doses of vitamin C of 250 grams and reports that he has had no problems. The Council for Responsible Nutrition has set an Upper Level (UL) of 2 grams, based on transient diarrhea. Their publication on vitamin C safety notes that "very large doses of vitamin C have been taken daily over the course of many years, and only minor undesirable effects have been attributed with any certainty to the vitamin's use[...] Clearly, vitamin C has a low order of toxicity".

## Alleged harmful effects

Reports of harmful effects of vitamin C tend to receive great prominence in the world's media. As such, these reports tend to generate much debate and more research into Vitamin C. Some of the harmful effects described below have been proven to be unfounded in later studies, while other effects are still undergoing further analysis.

- In April 1998 the journal *Nature* reported alleged carcinogenic and teratogenic effects of excessive doses of Vitamin C / ascorbic-acid. The effects were noted in test tube experiments and on only two of the 20 markers of free radical damage to DNA. They have not been supported by further evidence from living organisms.

- The authors of the study featured in *Nature* later clarified their position in correspondence to the journal, stating that their results "show a definite increase in 8-oxoadenine after supplementation with Vitamin C. This lesion is at least ten times less mutagenic than 8-oxoguanine, and hence our study shows an overall profound protective effect of this vitamin".

- In April 2000, University of Southern California researchers reported a thickening of the arteries of the neck in persons taking high vitamin C doses. It was later pointed out by vitamin C advocates that this can be explained by vitamin C's

collagen synthesising role leading to thicker and stronger artery walls. (ref. para 10)

- In June 2004, Duke University researchers reported an increased susceptibility to osteo-arthritis in guinea pigs fed a diet high in vitamin C. However, a 2003 study at Umeå University in Sweden, found that "the plasma levels of vitamin C, retinol and uric acid were inversely correlated to variables related to rheumatoid arthritis disease activity."

- A speculated increased risk of kidney stones may be a side effect of taking Vitamin C in larger than normal amounts (>1g). The potential mechanism of action is through the metabolism of Vitamin C (ascorbic acid) to dehydroascorbic acid, which is then metabolized to oxalic acid, a known constituent of kidney stones. However, this oxalate issue is still controversial, with evidence being presented for and against the possibility of this side effect. Vitamin C has long been advocated, and used, by some less conventional physicians to prevent or alleviate some kinds of ***non***-oxalate kidney stone formation. after addressing the oxalate issue. Vitamin B6 may mitigate the general risk of oxalate stones by decreasing oxalate production. Additionally, thiamine may inhibit oxalate formation. Furthermore, correcting any magnesium deficiency may decrease the risk of kidney stones by decreasing oxalate crystallization. Increasing one's fluid intake also helps to prevent oxalate crystallization in the kidney. There is evidence that certain intestinal flora influence how much oxalate is destroyed and that their absence is a significant causal risk factor in oxalate stone formers. Patients with a predispostion to form oxalate stonesor those on hemodialysis should avoid excess use of vitamin C.

- "Rebound scurvy" is a theoretical, never observed, condition that could occur when daily intake of Vitamin C is rapidly reduced from a very large amount to a relatively low amount. Advocates suggest this is an exaggeration of the *rebound effect* which occurs because ascorbate-dependent enzyme reactions continue for 24-48 hours after intake is lowered, and use up vitamin C which is not being replenished. The effect is to lower one's serum vitamin C blood concentration to less than normal for a short amount of time. During this period of time there is a slight risk of cold or flu infection through reduced resistance. Within a couple of days the enzyme reactions shut down and blood serum returns to the normal level of someone not taking large supplements. This is not scurvy, which takes weeks of zero vitamin C consumption to produce symptoms. It is something people who take large vitamin C supplements need to be aware of in order to gradually reduce dosage rather than quit taking Vitamin C suddenly. (ref. para 4) This is a theoretical risk for those taking supplements - e.g. if they find themselves severely ill, and in a hospital without the supplements, at a time when they need normal or better levels of vitamin C to fight the disease (ref. and search for "The major problem"). At this time, many doctors and hospital staff do not know much about nor administer megadosing of supplements, so that patients may have to rely on friends or relatives to bring them their supplements.

- Some writers have identified a theoretical risk of poor Copper absorption from high doses of Vitamin C, although little experimental evidence supports this. However, ceruloplasmin levels seem specifically lowered by high vitamin C intake. In one study, 600 milligrams of Vitamin C daily did not decrease copper absorption or overall body copper status in young men, but led to lower ceruloplasmin levels similar to those caused by copper deficiency. In another, ceruloplasmin levels were significantly reduced.

- There are stories circulating among some folk remedy proponants that doses of around 12 grams per day of Vitamin C can induce an abortion in women under 4 weeks of pregnancy. This is not supported by scientific research however.

- Recent studies into the use of a combination of Vitamin E (naturally occurring) and C in preventing oxidative stress leading to pre-eclampsia have failed to show any benefit, but did decrease average gestational time resulting in a higher incidence of low birthweight babies in one study.

## Conflicts with prescription drugs

Pharmaceuticals designed to reduce stomach acid such as the proton pump inhibitors , e.g. Omeprazole, among the most widely-selling drugs in the world, have been found to lower the bio availability of vitamin C by two thirds.

# Iodine

**Iodine** (IPA: /  ə( ) di n/, Greek: *iodes*, meaning "violet"), is a chemical element in the periodic table that has the symbol **I** and atomic number 53. Chemically, iodine is the least reactive of the halogens, and the most electropositive halogen after astatine. Iodine is primarily used in medicine, photography and dyes. It is required in trace amounts by most living organisms.

As with all other halogens (members of Group VII in the Periodic Table), iodine forms diatomic molecules, and hence, has the molecular formula of $\mathbf{I_2}$.

## Occurrence on earth

Iodine naturally occurs in the environment chiefly as dissolved iodide in seawater, although it is also found in some minerals and soils. The element may be prepared in an ultrapure form through the reaction of potassium iodide and copper.

sulfate. There are also several other methods of isolating this element. Although the element is actually quite rare, kelp and

| | |
|---|---|
| **53** | tellurium ← iodine → xenon |
| Br ↑ **I** ↓ At |   Periodic Table - Extended Periodic Table |
| **General** | |
| Name, Symbol, Number | iodine, I, 53 |
| Chemical series | halogens |
| Group, Period, Block | 17, 5, p |
| Appearance | violet-dark gray, lustrous  |
| Atomic mass | 126.90447(3) g/mol |
| Electron configuration | [Kr] $4d^{10}$ $5s^2$ $5p^5$ |
| Electrons per shell | 2, 8, 18, 18, 7 |
| **Physical properties** | |
| Phase | solid |
| Density (near r.t.) | 4.933 g·cm$^{-3}$ |
| Melting point | 386.85 K<br>(113.7 °C, 236.66 °F) |
| Boiling point | 457.4 K<br>(184.3 °C, 363.7 °F) |
| Critical point | 819 K, 11.7 MPa |
| Heat of fusion | ($I_2$) 15.52 kJ·mol$^{-1}$ |
| Heat of vaporization | ($I_2$) 41.57 kJ·mol$^{-1}$ |
| Heat capacity | (25 °C) ($I_2$) 54.44 J·mol$^{-1}$·K$^{-1}$ |

| Vapor pressure (rhombic) | | | | | | |
|---|---|---|---|---|---|---|
| *P*/Pa | 1 | 10 | 100 | 1 k | 10 k | 100 k |
| at *T*/K | 260 | 282 | 309 | 342 | 381 | 457 |

| | |
|---|---|
| **Atomic properties** | |
| Crystal structure | orthorhombic |
| Oxidation states | ±1, 5, 7<br>(strongly acidic oxide) |
| Electronegativity | 2.66 (Pauling scale) |
| | 1st: 1008.4 kJ/mol |

certain other plants have the ability to concentrate iodine, which helps introduce the element into the food chain as well as keeping its cost down. PIMP LIKE WHAT

## Uses

Iodine is used in pharmaceuticals, antiseptics, medicine, food supplements, dyes, catalysts and photography

## Isotopes

There are 37 isotopes of iodine and only one, $^{127}I$, is stable.

In many ways, $^{129}I$ is similar to $^{36}Cl$. It is a soluble halogen, fairly non-reactive, exists mainly as a non-sorbing anion, and is produced by cosmogenic, thermonuclear, and in-situ reactions. In hydrologic studies, $^{129}I$ concentrations are usually reported as the ratio of $^{129}I$ to total I (which is virtually all $^{127}I$). As is the case with $^{36}Cl/Cl$, $^{129}I/I$ ratios in nature are quite small, $10^{-14}$ to $10^{-10}$ (peak thermonuclear $^{129}I/I$ during the 1960s and 1970s reached about $10^{-7}$). $^{129}I$ differs from $^{36}Cl$ in that its half-life is longer (15.7 vs. 0.301 million years), it is highly biophilic, and occurs in multiple ionic forms (commonly, $I^-$ and $IO_3^-$) which have different chemical behaviors. This makes it fairly easy for $^{129}I$ to enter the biosphere as it becomes incorporated into vegetation, soil, milk, animal tissue, etc.

Excesses of stable $^{129}Xe$ in meteorites have been shown to result from decay of "primordial" $^{129}I$ produced newly by the supernovas which created the dust and gas from which the solar system formed. $^{129}I$ was the first extinct radionuclide to be identified as present in the early solar system. Its decay is the basis of the I-Xe radiometric dating scheme, which covers the first 50 million years of solar system evolution.

Effects of various radioiodine isotopes in biology are discussed below.

## Notable characteristics

Iodine is a dark-gray/purple-black solid that sublimes at standard temperatures into a purple-pink gas that has an irritating odor. This halogen forms compounds with many elements, but is less active than the other members of its Group VII (halogens) and has some metallic-like properties. Iodine dissolves easily in chloroform, carbon tetrachloride,

or carbon disulphide to form purple solutions (It is only slightly soluble in water, giving a yellow solution). The deep blue color of starch-iodine complexes is produced only by the free element.

Many students who have seen the classroom demonstration where iodine crystals are gently heated in a test tube come away with the impression that liquid iodine cannot exist at atmospheric pressure. This misconception arises because sublimation occurs without the intermediacy of liquid. The truth is that if iodine crystals are heated carefully to their melting point of 113.7 °C, the crystals will fuse into a liquid, which will be present under a dense blanket of the vapour.

# Descriptive Chemistry

Elemental iodine is poorly soluble in water, with one gram dissolving in 3450 ml at 20 °C and 1280 ml at 50 °C. By contrast with chlorine, the formation of the hypohalite ion ($IO^-$) in neutral aqueous solutions of iodine is negligible.

$$I_2 + H_2O \quad H^+ + I^- + HIO \quad (K = 2.0\times10^{-13})$$

Solubility in water is greatly improved if the solution contains dissolved iodides such as hydroiodic acid, potassium iodide, or sodium iodide. Dissolved bromides also improve water solubility of iodine. Iodine is soluble in a number of organic solvents, including ethanol (20.5 g/100 ml at 15 °C, 21.43 g/100 ml at 25 °C), diethyl ether (20.6 g/100 ml at 17 °C, 25.20 g/100 ml at 25 °C), chloroform, acetic acid, glycerol, benzene (14.09 g/100 ml at 25 °C), carbon tetrachloride (2.603 g/100 ml at 35 °C), and carbon disulfide (16.47 g/100 ml at 25 °C). Aqueous and ethanol solutions are brown. Solutions in chloroform, carbon tetrachloride, and carbon disulfide are violet.

Elemental iodine can be prepared by oxidizing iodides with chlorine:

$$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$$

or with manganese dioxide in acid solution:

$$2I^- + 4H^+ + MnO_2 \rightarrow I_2 + 2H_2O + Mn^{++}$$

Iodine is reduced to hydroiodic acid by hydrogen sulfide:

$$I_2 + H_2S \rightarrow 2HI + S\downarrow$$

or by hydrazine:

$$2I_2 + N_2H_4 \rightarrow 4HI + N_2$$

Iodine is oxidized to iodate by nitric acid:

$$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$$

or by chlorates:

$$I_2 + 2ClO_3^- \rightarrow 2IO_3^- + Cl_2$$

Iodine is converted in a two stage reaction to iodide and iodate in solutions of alkali hydroxides (such as sodium hydroxide):

$$I_2 + 2OH^- \rightarrow I^- + IO^- + H_2O \quad (K = 30)$$
$$3IO^- \rightarrow 2I^- + IO_3^- \quad (K = 10^{20})$$

# History

Iodine was discovered by Bernard Courtois in 1811. He was born to a manufacturer of saltpeter (potassium nitrate, a vital part of gunpowder). At the time France was at war, saltpeter, a component of gunpowder, was in great demand. Saltpeter produced from French niter beds required sodium carbonate, which could be isolated from seaweed washed up on the coasts of Normandy and Brittany. To isolate the sodium carbonate, seaweed was burned and the ash then washed with water. The remaining waste was destroyed by adding sulfuric acid. One day Courtois added too much sulfuric acid and a cloud of purple vapor rose. Courtois noted that the vapor crystallized on cold surfaces making dark crystals. Courtois suspected that this was a new element but lacked the money to pursue his observations.

However he gave samples to his friends, Charles Bernard Desormes (1777 - 1862) and Nicolas Clément (1779 - 1841) to continue research. He also gave some of the substance to Joseph Louis Gay-Lussac (1778 - 1850), a well-known chemist at that time, and to André-Marie Ampère (1775 - 1836). On 29 November 1813 Dersormes and Clément made public Courtois' discovery. They described the substance to a meeting of the Imperial Institute of France. On December 6 Gay-Lussac announced that the new substance was either an element or a compound of oxygen. Ampère had given some of

his sample to Humphry Davy (1778 - 1829). Davy did some experiments on the substance and noted its similarity to chlorine. Davy sent a letter dated December 10 to the Royal Society of London stating that he had identified a new element. A large argument erupted between Davy and Gay-Lussac over who identified iodine first but both scientists acknowledged Barnard Courtois as the first to isolate the chemical element.

# Notable inorganic iodine compounds

- Ammonium iodide ($NH_4I$)
- Caesium iodide (CsI)
- Copper(I) iodide (CuI)
- Hydroiodic acid (HI)
- Iodic acid ($HIO_3$)
- Iodine cyanide (ICN)
- Iodine heptafluoride ($IF_7$)
- Iodine pentafluoride ($IF_5$)
- Lead(II) iodide ($PbI_2$)
- Lithium iodide (LiI)
- Nitrogen triiodide ($NI_3$)
- Potassium iodide (KI)
- Sodium iodide (NaI)

*iodine compounds*

# Stable iodine in biology

One of the halogens, iodine is an essential trace element; the thyroid hormones, *thyroxine* and *triiodothyronine* contain iodine.

Iodine has a single known role in biology: it is an essential trace element since the thyroid hormones, *thyroxine* (T4) and *triiodothyronine* (T3) contain iodine. These are made from addition condensation products of the amino acid tyrosine, and are stored prior to release in a protein-like molecule called thryroglobulin. T4 and T3 contain four and three atoms of iodine per molecule, respectively. The thyroid gland actively absorbs iodide ion from the blood to make and release these hormones into the blood, actions which are regulated by a second hormone TSH from the pituitary. Thyroid hormones are phylogenetically very old molecules which are sythesized by most multicellular organisms, and which even have some effect on unicellular organisms.

Thyroid hormones play a very basic role in biology, acting on gene transcription to regulate the basal metabolic rate. The total deficiency of thyroid hormones can reduce basal metabolic rate up to 50%, while in excessive production of thyroid hormones the basal metabolic rate can be increased by 100%. T4 acts largely as a precursor to T3, which is (with some minor exceptions) the biologically active hormone.

## Dietary intake

The United States Food and Drug Administration recommends (21 CFR 101.9 (c)(8)(iv)) 150 micrograms of iodine per day for both men and women. This is necessary for proper production of thyroid hormone. Natural sources of iodine include seaweed, such as kelp and seafood.  Salt for human consumption is often enriched with iodine and is referred to as iodized salt.

## Iodine deficiency

In areas where there is little iodine in the diet—typically remote inland areas and semi-arid equatorial climates where no marine foods are eaten—iodine deficiency gives rise to goiter, so called endemic goiter. The mechanism is that low amounts of thyroid hormone in the blood due to lack of iodine to make them, give rise to high levels of the pituitary hormone TSH, which in turn stimulates abnormal growth of the thyroid gland. In some such areas, this is now combatted by the addition of small amounts of iodine to table salt in form of sodium iodide, potassium iodide, potassium iodate—this product is known as *iodized salt*. Iodine compounds have also been added to other foodstuffs, such as flour, in areas of deficiency.

Iodine deficiency is the leading cause of preventable mental retardation, an effect which happens primarily when babies and small children are made hypothyroid by lack of the element (this condition in adults results in mental slowing, but by itself, almost never causes severe or irreversible mental problems). Iodine deficiency remains a serious public health problem in developing countries.

## Toxicity of Iodine

Excess iodine has symptoms similar to those of iodine deficiency. Commonly encountered symptoms are abnormal growth of the thyroid gland and disorders in functioning and growth of the organism as a whole.

Elemental iodine, $I_2$, is deadly poison if taken in larger amounts; if 2-3 grams of it is consumed, it is fatal to humans.

Iodides are similar in toxicity to bromides.

# Radioiodine and biology

## Radioiodine and the thyroid

The artificial radioisotope $^{131}I$ (a beta emitter), also known as radioiodine which has a half-life of 8.0207 days, has been used in treating cancer and other pathologies of the thyroid glands. $^{123}I$ is the radioisotope most often used in nuclear imaging of the kidney and thyroid as well as thyroid uptake scans (used for the evaluation of Grave's disease). The most common compounds of iodine are the iodides of sodium and potassium (KI) and the iodates ($KIO_3$).

$^{129}I$ (half-life 15.7 million years) is a product of $^{130}Xe$ spallation in the atmosphere and uranium and plutonium fission, both in subsurface rocks and nuclear reactors. Nuclear processes, in particular nuclear fuel reprocessing and atmospheric nuclear weapons tests have now swamped the natural signal for this isotope. $^{129}I$ was used in rainwater studies following the Chernobyl accident. It also has been used as a ground-water tracer and as an indicator of nuclear waste dispersion into the natural environment.

If humans are exposed to radioactive iodine, the thyroid gland will absorb it as if it were non-radioactive iodine, leading to elevated chances of thyroid cancer. Isotopes with shorter half-lifes such as $^{131}I$ present a greater risk than those with longer half-lives since they generate more radiation per unit of time. Taking large amounts of regular iodine will saturate the thyroid and prevent uptake. Iodine pills are sometimes distributed to persons living close to nuclear establishments, for use in case of accidents that could lead to releases of radioactive iodine.

- Iodine-123 and iodine-125 are used in medicine as tracers for imaging and evaluating the function of the thyroid.

- Iodine-131 is used in medicine for treatment of thyroid cancer and Grave's disease.
- Uncombined (elemental) iodine is mildly toxic to all living things.
- Potassium iodide (KI tablets, or "SSKI" = "Super-Saturated KI" liquid drops) can be given to people in a nuclear disaster area when fission has taken place, to flush out the radioactive iodine-131 fission product. The half-life of iodine-131 is only eight days, so the treatment would need to continue only a couple of weeks. In cases of leakage of certain nuclear materials without fission, or certain types of dirty bomb made with other than radioiodine, this precaution would be of no avail.

### Radioiodine and the kidney

In the 1970s imaging techniques were developed in California to utilize radioiodine in diagnostics for renal hypertension.

## Non-hormone-related applications of iodine

- Tincture of iodine (3% elemental iodine in water/ethanol base) is an essential component of any emergency survival kit, used both to disinfect wounds and to sanitize surface water for drinking (3 drops per liter, let stand for 30 minutes). Alcohol-free iodine solutions such as Lugol's iodine, as well as other free iodine-providing antiseptics iodophors, are also available as effective elemental iodine sources for this purpose.
- Iodine compounds are important in the field of organic chemistry and are very useful in medicine.
- Silver iodide is used in photography.
- Tungsten iodide is used to stabilize the filaments in light bulbs.
- Nitrogen triiodide is an explosive, too unstable to be used commercially, but is commonly used in college pranks.

## Precautions for stable iodine

Direct contact with skin can cause lesions, so it should be handled with care. Iodine vapor is very irritating to the eye and to mucous membranes. Concentration of iodine in the air should not exceed 1 mg/m$^3$ (eight-hour time-weighted average). When mixed with ammonia, it can form nitrogen triiodide which is extremely sensitive and can explode unexpectedly.

## Clandestine Use

In the United States, the Drug Enforcement Agency (DEA) regards iodine and compounds containing iodine (ionic iodides, iodoform, ethyl iodide, and so on) as reagents useful for the clandestine manufacture of methamphetamine. Persons who attempt to purchase significant quantities of such chemicals without establishing a legitimate use are likely to find themselves the target of a DEA investigation. Persons selling such compounds without doing due diligence to establish that the materials are not being diverted to clandestine use may be subject to stiff fines

# Sources of vitamin C

Vitamin C is obtained through the diet by the vast majority of the world's population. The richest natural sources are fruits and vegetables, and of those, the camu camu fruit and the billygoat plum contain the highest concentration of the vitamin. It is also present in some cuts of meat, especially liver. Vitamin C is the most widely taken nutritional supplement and is available in a variety of forms from tablets and drink mixes to pure ascorbic acid crystals in capsules or as plain powder.

## Plant sources

Rose hips are a particularly rich source of vitamin C

Citrus fruits (orange, lemon, grapefruit, lime), tomatoes, and potatoes are good common sources of vitamin C. Other foods that are good sources of vitamin C include papaya, broccoli, brussels sprouts, black currants, strawberries, cauliflower, spinach, cantaloupe, kiwifruit, cranberries and red peppers.

Emblica officinalis often referred to as Indian gooseberry or amla, is one of the richest known sources of vitamin C (720 mg/100g of fresh pulp or up to 900 mg/100g of pressed juice.)– it contains 30 times the amount found in oranges.

The amount of vitamin C in foods of plant origin depends on:

- the precise variety of the plant,
- the soil condition
- the climate in which it grew,
- the length of time since it was picked,
- the storage conditions,

- the method of preparation. Cooking in particular is often said to destroy vitamin C - but see the section on Food preparation.

The following table is approximate and shows the relative abundance in different raw plant sources. The amount is given in miligrams per 100 grams of fruit or vegetable (in comparison, one teaspoon of pure vitamin C weighs 4,500 miligrams)...

| **Plant source** | **Amount** |
|---|---|
| Billy Goat plum | 3150 |
| Camu Camu | 2800 |
| Wolfberry | 2500 |
| Rose hip | 2000 |
| Acerola | 1600 |
| Amla | 720 |
| Seabuckthorn | 600 |
| Jujube | 500 |
| Baobab | 400 |
| Blackcurrant | 200 |
| Red pepper | 190 |

| | |
|---|---|
| Parsley | 130 |
| Guava | 100 |
| Kiwifruit | 90 |
| Broccoli | 90 |
| Loganberry | 80 |
| Redcurrant | 80 |
| Brussels sprouts | 80 |
| Lychee | 70 |
| Cloudberry | 60 |
| Persimmon | 60 |

| **Plant source** | **Amount** |
|---|---|
| Papaya | 60 |
| Strawberry | 60 |
| Orange | 50 |
| Lemon | 40 |

| | |
|---|---|
| Melon, cantaloupe | 40 |
| Cauliflower | 40 |
| Grapefruit | 30 |
| Raspberry | 30 |
| Tangerine | 30 |
| Mandarin orange | 30 |
| Passion fruit | 30 |
| Spinach | 30 |
| Cabbage raw green | 30 |
| Lime | 20 |
| Mango | 20 |
| Potato | 20 |
| Melon, honeydew | 20 |
| Tomato | 10 |
| Blueberry | 10 |

| | |
|---|---|
| Pineapple | 10 |
| Pawpaw | 10 |
| Grape | 10 |

| **Plant source** | **Amount** |
|---|---|
| Apricot | 10 |
| Plum | 10 |
| Watermelon | 10 |
| Banana | 9 |
| Carrot | 9 |
| Avocado | 8 |
| Crabapple | 8 |
| Peach | 7 |
| Apple | 6 |
| Blackberry | 6 |
| Beetroot | 5 |

| | |
|---|---|
| Pear | 4 |
| Lettuce | 4 |
| Cucumber | 3 |
| Eggplant | 2 |
| Fig | 2 |
| Bilberry | 1 |
| Horned melon | 0.5 |
| Medlar | 0.3 |

## Animal sources

Goats and most animals make their own vitamin C

The overwhelming majority of species of animals and plants synthesise their own vitamin C. It is therefore not a vitamin for them. Synthesis is achieved through a sequence of 4 enzyme driven steps, which convert glucose to ascorbic acid. It is carried out either in the kidneys, in reptiles and birds, or the liver, in mammals and perching birds. The last

enzyme in the process, l-gulonolactone oxidase, cannot be made by humans because the gene for this enzyme is defective (Pseudogene ΨGULO). The loss of an enzyme concerned with ascorbic acid synthesis has occurred quite frequently in evolution and has affected most fish; many birds; some bats; guinea pigs; and most primates, including humans. The mutations have not been lethal because ascorbic acid is so prevalent in the surrounding food sources (it may be noted that many of these species' diet consists largely of fruit).

For example an adult goat will manufacture more than 13,000 mg of vitamin C per day in normal health and as much as 100,000 mg daily when faced with life-threatening disease, trauma or stress.

Trauma or injury has been demonstrated to use up large quantities of vitamin C in animals, including humans.

It was only realised in the 1920s that some cuts of meat and fish are also a source of vitamin C for humans. The muscle and fat which make up the modern western diet are however poor sources. As with fruit and vegetables cooking degrades the vitamin C content.

Vitamin C is present in mother's milk and in less amounts in raw cow's milk (but pasteurized milk contains only trace amounts of the vitamin) .

The following table shows the relative abundance of vitamin C in various foods of animal origin, given in mg of vitamin C per 100 grams of food:

| **Food** | **Amount** |
|---|---|
| Calf liver (raw) | 36 |
| Beef liver (raw) | 31 |
| Oysters (raw) | 30 |

| | |
|---|---|
| Cod roe (fried) | 26 |
| Pork liver (raw) | 23 |
| Lamb brain (boiled) | 17 |
| Chicken liver (fried) | 13 |
| Lamb liver (fried) | 12 |
| Lamb heart (roast) | 11 |

| Food | Amount |
|---|---|
| Lamb tongue (stewed) | 6 |
| Human milk (fresh) | 4 |
| Goat milk (fresh) | 2 |
| Cow milk (fresh) | 2 |
| Beef steak (fried) | 0 |
| Hen's egg (raw) | 0 |
| Pork bacon (fried) | 0 |
| Calf veal cutlet (fried) | 0 |

| | |
|---|---|
| Chicken leg (roast) | 0 |

## Food preparation

It is important to choose a suitable method of food preparation that conserves vitamin C content. When cooking vegetables, one should seek to minimize temperature and duration of cooking and not discard water used in preparation (e.g., by steam cooking or by making soup). Food source vitamin C is identical to that in supplements. The structure of vitamin C is well understood, see ascorbic acid, and there is no difference in benefit between natural and synthetic forms (although fruits and vegetables contain various other nutrients, and vitamin C is not their only health benefit).

Recent observations suggest that the impact of temperature and cooking on vitamin C may have been overestimated:

1. Since it is water soluble, vitamin C will strongly leach into the cooking water while cooking most vegetables — but this doesn't necessarily mean the vitamin is destroyed — it's still there, but it's in the cooking water. (This may also suggest how the apparent misconception about the extent to which boiling temperatures destroy vitamin C might have been the result of flawed research: If the vitamin C content of vegetables (and not of the water) was measured subsequent to cooking them, then that content would have been much lower, though the vitamin has not actually been destroyed .)
2. Not only the temperature, but also the exposure time is significant. Contrary to what was previously and is still commonly assumed, it can take much longer than two or three minutes to destroy vitamin C at boiling point

It also appears that cooking doesn't necessarily leach vitamin C in all vegetables at the same rate; it has been suggested that the vitamin is not destroyed when boiling broccoli. This may be a result of vitamin C leaching into the cooking water at a slower rate from this vegetable.

Copper pots will destroy the vitamin.

Some research shows that fresh-cut fruit may not lose much of its nutrients when stored in the refrigerator for a few days.

Vitamin C enriched teas and infusions have increasingly appeared on supermarket shelves. Such products would be nonsense if boiling temperatures did indeed destroy vitamin C at the rate it had previously been suggested. It should be noted however that as of 2004 most academics not directly involved in vitamin C research still teach that boiling temperatures will destroy vitamin C *very* rapidly.

### Vitamin C supplements

Vitamin C is the most widely taken dietary supplement. It is available in many forms including tablets, capsules, drink mix packets, in multi-vitamin formulations and as chemically pure crystaline powder. Tablet and capsule sizes range from 25mg to 1500mg. Vitamin C (ascorbic acid) crystals are typically available in bottles containing 300g to 1 kg of powder (a teaspoon of vitamin C crystals equals 4,500mg).

### Methods of manufacture (chemical synthesis)

Vitamin C is produced from glucose by two main routes. The Reichstein process developed in the 1930s uses a single pre-fermentation followed by a purely chemical route. The more modern Two-Step fermentation process was originally developed in China in the 1960s, uses additional fermentation to replace part of the later chemical stages. Both processes yield approximately 60% vitamin C from the glucose feed.

Research is underway at the Scottish Crop Research Institute to create yeast micro organisms to synthesise ascorbic acid in a single fermentation step, a technology which is expected to reduce manufacturing costs considerably.

World production of synthesised vitamin C is currently estimated at approximately 110,000 tonnes annually. Main producers today are BASF/Takeda, DSM, Merck and the China Pharmaceutical Group Ltd. of the People's Republic of China. China is slowly becoming the major world supplier as its prices undercut those of the US and European manufacturers.

## Discovery and history

The need to include fresh plant food or raw animal flesh in the diet to prevent disease was known from ancient times. Native peoples living in marginal areas incorporated this into their medicinal lore. For example, infusions of spruce needles were used in the temperate

zones, or the leaves from species of drought-resistant trees in desert areas. In 1536, the French explorer Jacques Cartier, exploring the St. Lawrence River, used the local natives' knowledge to save his men who were dying of scurvy. He boiled the needles of the arbor vitae tree to make a tea that was later shown to contain 50 mg of vitamin C per 100 grams.

Through history the benefit of plant food for the survival of sieges and long sea voyages was recommended by enlightened authorities. John Woodall, the first appointed surgeon to the British East India Company, recommended the use of lemon juice as a preventive and cure in his book "The Surgeon's Mate" of 1617. The Dutch writer, Johann Bachstrom of Leyden, in 1734, gave the firm opinion that *"scurvy is solely owing to a total abstinence from fresh vegetable food, and greens; which is alone the primary cause of the disease."*

Citrus fruits were one of the first sources of vitamin C available to ship's surgeons.

The first attempt to give scientific basis for the cause of scurvy was by a ship's surgeon in the British Royal Navy, James Lind. While at sea in May 1747, Lind provided some crew members with two oranges and one lemon per day, in addition to normal rations, while others continued on cider, vinegar or sea water, along with their normal rations. In the history of science this is considered to be the first example of a controlled experiment comparing results on two populations of a factor applied to one group only with all other factors the same. The results conclusively showed that citrus fruits prevented the disease. Lind wrote up his work and published it in 1753, in *Treatise on the Scurvy*.

Lind's work was slow to be noticed, partly because he gave conflicting evidence within the book and partly because of social inertia in some elements at the British admiralty who saw care for the well-being of ships' crew as a sign of weakness. There was also the

fact that fresh fruit was very expensive to keep on board, whereas boiling it down to juice allowed easy storage but destroyed the vitamin. Ships' captains assumed wrongly that it didn't work, because the juice failed to cure scurvy.

It was 1795 before the British navy adopted lemons or lime as standard issue at sea. Limes were more popular as they could be found in British West Indian Colonies, unlike lemons which weren't found in British Dominions, and were therefore more expensive. (This practice led to the nickname limey for British people, especially British sailors.) Captain James Cook had previously demonstrated and proven the principle of the advantages of fresh and preserved foods, such as sauerkraut, by taking his crews to the Hawaiian islands and beyond without losing any of his men to scurvy. For this otherwise unheard of feat, he was awarded a medal by the British Admiralty. So the Navy was certainly well aware of the principle. The cost of providing fresh fruit on board was probably a factor in this long delay. Luxuries or non-standard supplies not provided by the Admiralty were usually provided by the Captains.

The name "antiscorbutic" was used in the eighteenth and nineteenth centuries as general term for those foods known to prevent scurvy, even though there was no understanding of the reason for this. These foods include lemons, limes, and oranges; sauerkraut, salted cabbage, malt, and portable soup were employed with variable effect.

In 1907, Axel Holst and Theodor Frølich, two Norwegian biochemists studying beriberi contracted aboard ship's crews in the Norwegian Fishing Fleet, wanted a small test mammal to substitute for the pigeons they used. They fed guinea pigs the test diet, which had earlier produced beriberi in their pigeons, and were surprised when scurvy resulted instead. Until that time scurvy had not been observed in any organism apart from humans, and it was considered an exclusively human disease.

In the early twentieth century, the Polish-American scientist Casimir Funk conducted research into deficiency diseases, and in 1912 Funk developed the concept of vitamins, for the elements in food which are essential to health. Then, from 1928 to 1933, the Hungarian research team of Joseph L Svirbely and Albert Szent-Györgyi and, independently, the American Charles Glen King, first isolated vitamin C and showed it to be ascorbic acid.

In 1928 the arctic anthropologist and adventurer Vilhjalmur Stefansson attempted to prove his theory of how Eskimo (Inuit) people are able to avoid scurvy with almost no

plant food in their diet. This had long been a puzzle because the disease had struck European Arctic explorers living on similar high-meat diets. Stefansson theorised that the native peoples of the Arctic got their vitamin C from fresh meat that was raw or minimally cooked. Starting in February 1928, for one year he and a colleague lived on an animal-flesh-only diet under medical supervision at New York's Bellevue Hospital; they remained healthy.

In 1933-1934, the British chemists Sir Walter Norman Haworth and Sir Edmund Hirst and, independently, the Polish Tadeus Reichstein, succeeded in synthesizing the vitamin, the first to be artificially produced. This made possible the cheap mass production of vitamin C. Haworth was awarded the 1937 Nobel Prize in Chemistry largely for this work. The synthetic form of the vitamin is identical to the natural form.

The Swiss pharmaceutical company Hoffmann-La Roche was the first to mass produce synthetic vitamin C, under the brand name of Redoxon, in 1934.

In 1959 the American J.J. Burns showed that the reason some mammals were susceptible to scurvy was the inability of their liver to produce the active enzyme L-gulonolactone oxidase, which is the last of the chain of four enzymes which synthesize ascorbic acid.

American biochemist Irwin Stone was the first to exploit Vitamin C for its food preservative properties and held patents on this. He developed the theory that vitamin C was an essential nutrient deficient in humans as a result of a genetic defect that afflicted the whole human race.

# Vitamin C hypothesis

Since its discovery Vitamin C has been considered a universal panacea by some, although this led to suspicions of it being overhyped by others.

The fact that man possesses three of the four enzymes that animals employ to manufacture ascorbates in relatively large amounts, has led researchers such as Irwin Stone and Linus Pauling to hypothesize that man's ancestors once manufactured this substance in the body millions of years ago in quantities roughly estimated at 3,000-4,000 mg daily, but later lost the ability to do this through a chance of evolution. If true, this would mean that vitamin C was misnamed as a vitamin and is in fact a vital macronutrient like fat or carbohydrate.{Irwin Stone: "The Healing Factor"}

Dr. Hickey, of Manchester Metropolitan University, believes that man carries a mutated and ineffective form of the genetic machinery for manufacturing the fourth of the four enzymes used by all mammals to make ascorbic acid. Cosmic rays or a retro virus could have caused this mutation, millions of years ago.{Hickey: "Ascorbate"} In humans the three surviving enzymes continue to produce the precursors to ascorbic acid but the process is incomplete and the body then disassembles them.

In the 1960s Nobel-Prize winning chemist Linus Pauling, after contact with Irwin Stone, began actively promoting vitamin C as a means to greatly improve human health and resistance to disease. His book *How to Live Longer and Feel Better* was a bestseller and advocated taking more than 10,000 milligrams per day. It sold widely and many advocates today see its influence as the reason there was a marked downward trend in US heart disease from the early 1980s onwards.

Stone's work also informed the practise of Dr. Robert F. Cathcart III, in the 1970s and 1980s. He applied extremely large doses of ascorbate (300 grams = 0.66 pounds per day) to a wide range of viral diseases with successful results. Cathcart developed the concept of Bowel tolerance, the use of the onset of diarrhea as an indication of when the body's true requirement of ascorbic acid had been reached. He found that seriously ill people could often tolerate levels of tens of grams per day before their tolerance limit is reached.

Matthias Rath is a controversial German physician who once worked with Pauling. He is an active proponent and publicist for high dose vitamin C. He has published a theory that deaths from scurvy in humans during the ice age, when vitamin C was scarce, selected for individuals who could repair arteries with a layer of cholesterol. He theorises that, although eventually harmful, cholesterol lining of artery walls would be beneficial in that it would keep the individual alive until access to Vitamin C allowed arterial damage to be repaired. Atherosclerosis is thus a vitamin C deficiency disease. Rath has also argued publicly that high doses of vitamin C can be effectively used against viral epidemics such as HIV, SARS and bird flu.

It has been suggested by some advocates that ascorbic acid is really a food group in its own right like carbohydrates or protein and should not be seen as a pharmaceutical or vitamin at all.{Irwin Stone: "The Healing Factor"}

## Chronic scurvy

Identified and named by Linus Pauling, "chronic scurvy" or "subclinical scurvy" is a condition of Vitamin C deficiency which is not as easily noticeable as acute scurvy (because chronic scurvy is mostly internal), characterized by micro lesions of tissues (such as that caused by blood pulsing through arteries, which stretches the arterial walls causing them to tear slightly). It is a major contributing factor to cardio vascular disease. The condition is almost entirely preventable with supplementation of larger doses of Vitamin C (8 grams or more per day). Chronic scurvy is commonplace, even in industrialized countries.

# Politics of Vitamin C

## Regulation

There are regulations in most countries which limit the claims on the treatment of disease that can be placed on food, drug, and nutrient product labels. Regulations include:

- Claims of therapeutic effect with respect to the treatment of any medical condition or disease are prohibited by the Food and Drug Administration (in the USA, and by the corresponding regulatory agencies in other countries) unless the substance has gone through a lengthy (10+ years) and expensive (200 million US dollars+) approval process, for which the applicant seeking approval must pay.
- In the United States, the following notice is mandatory on food, drug, and nutrient product labels which make health claims: *These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.* This statement must be included even if substantial scientific evidence exists showing that the message isn't true. This may lead consumers to the false belief that Vitamin C has no value in preventing or treating diseases other than scurvy (for which treatment claims are allowed).

## Advocacy arguments

Vitamin C advocates argue that there is a large body of scientific evidence that the vitamin has a wide range of health and therapeutic benefits but which they claim have been ignored. They claim the following factors affect the marketing and distribution of Vitamin C, and the dissemination of information concerning the nutrient:

- There is increasing evidence of the applications and efficacy of Vitamin C, but governmental agency dose and frequency of intake recommendations have remained relatively fixed. This has lead some researchers to challenge the recommendations. In 2003 Steve Hickey and Hilary Roberts of the Manchester

Metropolitan University published a fundamental criticism of the approach taken to fix the nutritional requirement of vitamin C. They again argued in 2004 that the RDA which is based on blood plasma and white blood cell saturation data from the National Institutes of Health (NIH) was based on flawed data. According to these authors, the doses required to achieve blood, tissue and body "saturation" are much larger than previously believed. They allege that the Institute of Medicine (IoM) and the NIH have failed to respond to an open letter from a number of scientists and medical researchers, notably Doctors Steve Hickey, Hilary Roberts, Ian Brighthope, Robert Cathcart, Abram Hoffer, Archie Kalokerinos, Tom Levy, Richard Passwater, Hugh Riordan, Andrew Saul and Patrick Holford, which called for revision of the RDI (Reference Daily Intake).

- Research and the treatment approval process are so expensive, pharmaceutical companies rarely apply for approval of an unpatentable product. To do so without the protection of a patent would allow competitors to manufacture the product too, which would drive the price (and profit margin) down to a point much less desirable than the price point (and profit margin) of patentable products. The lower price would also reduce the likelihood of recuperating the company's exorbitant research funding and treatment approval costs. Vitamin C is not eligible for patenting because it is a natural substance, and because it has already been marketed to the public for some time. As of yet, no company has applied to the FDA (nor paid) for approval of Vitamin C as a treatment for any disease.

- Companies selling a treatment product are not required to inform consumers or patients of other treatments, even if those treatments are more effective, less expensive, and have fewer side-effects. Medical practitioners are not required to inform their patients of treatments for which treatment approval has not been granted. This situation, coupled with the label censorship explained above makes it more difficult to keep the public informed about the benefits of and new discoveries concerning the applications and effective dosage levels of Vitamin C.

- Matthias Rath and others point to low doses of Vitamin C as the cause of the current epidemics of heart disease and cancer, and have termed the situation "a genocide", implying that health care providers (and particularly cardiologists and pharmaceutical companies) are aware of Vitamin C's benefits and are deliberately seeking to block its acceptance as a therapeutic agent. Meanwhile, governments, with their bureaucratic systems of treatment approval filtering out natural and inexpensive treatments such as those applying vitamin C, have also contributed to this technology blockade.

# Dietitian

**Dietitians** are experts in food and nutrition. They help promote good health through proper eating. They also supervise the preparation and service of food, develop modified diets, participate in research, and educate individuals and groups on good nutritional habits. The goals of the dietary department are to obtain, prepare, and serve flavorsome, attractive, and nutritious food to patients, family members, and health care providers.

Nutrition professionals include registered dietitians (RD) and dietetic technician, registered (DTR). Some RDs or DTRs call themselves nutritionists. However, some people who may call themselves a nutritionist are not registered dietitians. Sometimes the word dietitian is spelled as dietician.

Only certain countries, such as America have dietetic technicians. Dietetics technicians are not the same as dietitians in terms of responsibilities and qualifications.

## Types of dietitian

The majority of dietitians are *clinical*, or *therapeutic*, dietitians. Clinical dietitians review medical charts and talk with patients' families. They work with other health care professionals and community groups to provide nourishment, nutritional programs, and instructional presentations to benefit people of all ages, and with a variety of health conditions. This is accomplished by developing individual plans to meet nutritional needs. These plans include nourishment, tube feedings (called enteral nutrition), intravenous feedings (called parenteral nutrition) such as total parenteral nutrition (TPN), diets, and education. Clinical dietitians provide individual and group educational programs for patients and family members about their nutrition and health.

### Clinical dietitians

Clinical dietitians work in hospitals to provide medical nutrition therapy to patients according to the disease processes, provides individual inpatient and outpatient dietary consultations to patients and their family members and also conduct group educations for other health workers, patients and the public. They work as a team with the physicians, physical therapists, occupational therapists, speech therapists, social workers and nurses to provide care to the patients.

## Community dietitians

Community dietitians work with wellness programs and international health organizations. These dietitians apply and distribute knowledge about food and nutrition to specific life-styles and geographic areas. They coordinate nutritional programs in public health agencies, daycare centers, health clubs, and recreational camps and resorts. Some community dietitians carry out clinical based patient care in the form of home visits for patients who are too ill to physically attend consultation in health facilites.

## Foodservice dietitians

Foodservice dietitians or managers are responsible for large-scale food planning and service. They coordinate, assess and plan foodservice processes in health care facilities, school food service programs, prisons, cafeterias, and restaurants. They direct and manages the operational and nutrition services staffs such as kitchen staffs, delivery staffs and dietary assistants or diet aides.

## Research dietitians

Research dietitians are mostly involved with dietary related research in the clinical aspect of nutrition in disease states, public aspect on primary, secondary and sometimes tertiary health prevention and foodservice aspect in issues involving the food prepared for patients. Research Dietitians normally work in a hospital or research facilities. It should be noted that some Clinical dietitian's roles also involve research other than the normal clinical workload. Quality improvement in dietetics services is also one area of research.

## Administrative dietitians

Administrative, or management or Director of Dietetics Department or Nutrition Services, sometimes also known as *Manager* instead of Director depending on the size, number of dietitians in the department and also the organisational structure adopted by the Health facilities or Hospital. Director or Manager act as head of the dietitians. They also hire, train, direct, supervise employees and manage dietary departments

## Business dietitians

Business dietitians serve as resource people for the media. They work as sales representatives for food manufacturing companies that provide nutritional supplements and tube feeding supplies.

### Consultant dietitians

Consultant dietitians work under private practice. They contract independently to provide nutrition services and educational programs to individuals, nursing homes, and in health care facilities.

## Other Nutrition Workers

### Dietary Assistants

Dietary Assistants or Dietary Aides are responsible for assisting and carrying out the medical nutrition therapy prescribed by the Dietitians and to ensure that food for the patients as instructed by the Dietitians are carried out correctly by checking menus against recent diet orders before tray assembly begins and being physically present in the kitchen plating-lines at meal hours. Dietary aides in some countries might also carry out a simple initial health screening for newly admitted patients and only inform the Dietitians if any screened patients requires a Dietitian's expertise for further assessments or interventions.

### Dietary clerks

*Dietary clerks* perform clerical tasks such as entry and maintenance of dietary requirements to a database. They also track financial information, such as the number of meals served each day.

### Dietary managers

*Dietary managers* are responsible for retail, catering, and tray lines. If an operation is large, there may be one or more managers to help in directing the dietary workers.

### Dietary workers

*Dietary workers* prepare the food and meal trays in the kitchen. They check for accuracy and completeness. They also maintain the storage area for food supplies and ensure

practice of sanitary procedures. Dietary workers are trained on the job and can work in any commercial kitchen.

### Dietary workers

*Dietary hosts* or *hostesses* deliver and bring back the meal trays to patients. They distribute and collect menus and help the patients to make complete selections.

# Qualification

A Dietitian's education in Health science involves significant scientific based knowledge in Anatomy, Chemistry, Biochemistry, Biology, Physiology, Nutrition & Medical Science. It is these strong foundations in advanced scientific knowledge equipped with counselling skills and aspects of psychology which enables a Dietitian to assess, analyse, intervene and educate a patient in relation to the diet and disease.

It can be said that in an Interdisciplinary team (consisting of the Physician, Dietitian, Speech Therapist, Physiotherapist, Occupational Therapist, Social worker and Nurses), the Physician and the Dietitian are the two health professionals with the most well rounded knowledge on human biochemistry and physiology.

**There are a few different academic routes to becoming a fully qualified registrable Dietitian;**

- A professional undergraduate Bachelor degree in Dietetics which requires four years of studies

***or***

- A Bachelor of science degree and a Postgraduate diploma in Dietetics

***or***

- A Bachelor of science degree and a Masters in Dietetics

Besides academic education, registered dietitians must complete up to a year long dietetic internship before they can sit for the registration examination. The dietetic internship requires the intern to complete several areas of competency including rotations in

clinical, community, long-term care nutrition as well as food service, public health and a variety of other worksites.

Once the degree is earned, the internship complete and registration examination passed, the dietitian is able to work in a variety of professional settings. Most states require additional licensure to work in most settings. To maintain, the RD credential, professionals must participate in and earn continuing education units on a yearly basis.

**Calcium** (IPA: /  kalsiəm/) is the chemical element in the periodic table that has the symbol **Ca** and atomic number 20. Calcium is a soft grey alkaline earth metal that is used as a reducing agent in the extraction of thorium, zirconium and uranium. Calcium is also the fifth most abundant element in the Earth's crust. It is essential for living organisms, particularly in cell physiology, and is the most common metal in many animals.

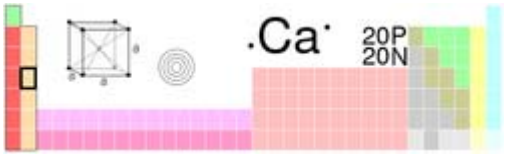
## Notable characteristics

Calcium is a rather soft, gray, metallic element that can be extracted by electrolysis from calcium fluoride. It burns with a yellow-red flame and forms a white nitride coating when exposed to air. It reacts with water, displacing hydrogen and forming calcium hydroxide.

Calcium is essential in muscle contraction, oocyte activation, building strong bones and teeth, blood clotting, nerve impulse transmission, regulating heartbeat, and fluid balance within cells. In the U.S., between about 50% and 75% of adults do not get sufficient calcium in their diet. Adults need

potassium ← calcium → scandium

Mg
↑
**Ca**
↓
Sr




Periodic Table - Extended Periodic Table

| **General** | |
|---|---|
| Name, Symbol, Number | calcium, Ca, 20 |
| Chemical series | alkaline earth metals |
| Group, Period, Block | 2, 4, s |
| Appearance | silvery white  |
| Atomic mass | 40.078(4) g/mol |
| Electron configuration | [Ar] $4s^2$ |
| Electrons per shell | 2, 8, 8, 2 |
| **Physical properties** | |
| Phase | solid |
| Density (near r.t.) | 1.55 $g \cdot cm^{-3}$ |
| Liquid density at m.p. | 1.378 $g \cdot cm^{-3}$ |
| Melting point | 1115 K<br>(842 °C, 1548 °F) |
| Boiling point | 1757 K<br>(1484 °C, 2703 °F) |
| Heat of fusion | 8.54 $kJ \cdot mol^{-1}$ |
| Heat of vaporization | 154.7 $kJ \cdot mol^{-1}$ |
| Heat capacity | (25 °C) 25.929 $J \cdot mol^{-1} \cdot K^{-1}$ |

| Vapor pressure | | | | | | |
|---|---|---|---|---|---|---|
| *P*/Pa | 1 | 10 | 100 | 1 k | 10 k | 100 k |
| at *T*/K | 864 | 956 | 1071 | 1227 | 1443 | 1755 |

| **Atomic properties** | |
|---|---|
| Crystal structure | cubic face centered |
| Oxidation states | 2<br>(strongly basic oxide) |
| Electronegativity | 1.00 (Pauling scale) |
| | 1st: 589.8 $kJ \cdot mol^{-1}$ |
| | 2nd: 1145.4 $kJ \cdot mol^{-1}$ |

between 1,000 and 1,300 mg of calcium in their daily diet.

The most abundant isotope, $^{40}Ca$, has a nucleus of 20 protons and 20 neutrons. Its electron configuration is: 2 electrons in the K shell (principal quantum number 1), 8 in the L shell (principal quantum number 2), 8 in the M shell (principal quantum number 3), and 2 in the N shell (principal quantum number 4). The outer shell is the valence shell, with 2 electrons in the lone 4s orbital, the 3d orbitals being empty.

# Occurrence

Calcium is not naturally found in its elemental state. Calcium is found mostly in soil systems as limestone, gypsum and fluorite. Stalagmites and stalactites contain calcium carbonate. Being an essential macromineral in the human diet, soil conservation practices often consider the sustainable equilibrium of calcium concentrations in the earth.

*Calcium minerals.*

# Applications

Uses include:

- as a reducing agent in the extraction of other metals, such as uranium, zirconium, and thorium.
- as a deoxidizer, desulfurizer, or decarbonizer for various ferrous and nonferrous alloys.
- as an alloying agent used in the production of aluminium, beryllium, copper, lead, and magnesium alloys.
- in the making of cements and mortars to be used in construction.

# History

Calcium (Latin *calcis*, meaning "lime") was known as early as the first century when the Ancient Romans prepared lime as calcium oxide. It was not actually isolated until 1808 in England when Sir Humphry Davy electrolyzed a mixture of lime and mercuric oxide. Davy was trying to isolate calcium and when he heard that Berzelius and Pontin prepared calcium amalgam by electrolyzing lime in mercury, he tried it himself. He worked with electrolysis throughout his life and also discovered/isolated magnesium, strontium and barium.

# Compounds

Calcium, combined with phosphate to form hydroxylapatite, is the mineral portion of human and animal bones and teeth. The mineral portion of some corals can also be transformed into hydroxylapatite.

Calcium oxide (lime) is used in many chemical refinery processes and is made by heating and carefully adding water to limestone. When lime is mixed with sand, it hardens into a mortar and is turned into plaster by carbon dioxide uptake. Mixed with other compounds, lime forms an important part of Portland cement.

When water percolates through limestone or other soluble carbonate rocks, it partially dissolves part of the rock and causes cave formation and characteristic stalactites and stalagmites and also forms hard water. Other important calcium compounds are nitrate, sulfide, chloride, carbide, cyanamide, and hypochlorite.

# Isotopes

Calcium has four stable isotopes ($^{40}$Ca and $^{42}$Ca through $^{44}$Ca), plus two more isotopes ($^{46}$Ca and $^{48}$Ca) that have such long half-lives that for all practical purposes they can be considered stable. It also has a cosmogenic isotope, radioactive $^{41}$Ca, which has a half-life of 103,000 years. Unlike cosmogenic isotopes that are produced in the atmosphere, $^{41}$Ca is produced by neutron activation of $^{40}$Ca. Most of its production is in the upper metre or so of the soil column where the cosmogenic neutron flux is still sufficiently strong. $^{41}$Ca has received much attention in stellar studies because it decays to $^{41}$K, a critical indicator of solar-system anomalies.

97% of naturally occurring calcium is in the form of $^{40}$Ca. $^{40}$Ca is one of the daughter products of $^{40}$K decay, along with $^{40}$Ar. While K-Ar dating has been used extensively in the geological sciences, the prevalence of $^{40}$Ca in nature has impeded its use in dating. Techniques using mass spectrometry and a double spike isotope dilution have been used for K-Ca age dating.

# Nutrition

Calcium is an important component of a healthy diet. A deficit can affect bone and tooth formation, while overretention can cause kidney stones. Vitamin D is needed to absorb

calcium. Dairy products, such as milk and cheese, are a well-known source of calcium. However, some individuals are allergic to dairy products and even more people, particularly those of non-European descent, are lactose-intolerant, leaving them unable to consume dairy products. Fortunately, many other good sources of calcium exist. These include: seaweeds such as kelp, wakame and hijiki; nuts and seeds (like almonds and sesame); beans; amaranth; collard greens; okra; rutabaga; broccoli; kale; and fortified products such as orange juice and soy milk. Calcium has also been found to assist in the production of lymphatic fluids.

Calcium is essential for the normal growth and maintenance of bones and teeth, and calcium requirements must be met throughout life. Requirements are greatest during periods of growth, such as childhood, during pregnancy and when breast-feeding. Long-term calcium deficiency can lead to osteoporosis, in which the bone deteriorates and there is an increased risk of fractures. Adults need between 1,000 and 1,300 mg of calcium in their daily diet.

Recommended Adequate Intake by the IOM for Calcium:

Age----------Calcium (mg/day)

0 to 6 months----------210

7 to 12 months----------270

1 to 3 years----------500

4 to 8 years----------800

9 to 13 years----------1300

14 to 18 years----------1300

19 to 50 years----------1000

51+ years----------1200

For more information about calcium in living nature, see calcium in biology and calcium metabolism.

### Dietary sources of calcium

***Calcium*** is found in significant amounts in many foods, including broccoli, kale, dandelion greens, collard greens, almonds, sesame seeds, blackstrap molasses, beans, and fortified beverages such as soy milk and orange juice. The calcium content of most foods can be found in the USDA National Nutrient Database.

Dairy products (such as milk, yogurt and cheese) do contain calcium, however they are not recommended as a dietary source because they contain a significant amount of saturated fat, which can contribute to cardiovascular disease. The calcium content of dairy products is also misleading because most of the calcium is used by the body in the digestion of milk protein (casein). This can lead to calcium deficiency and osteoporosis.

However, calcium in dairy products is usually much more absorbable to human body than other sources of calcium such as plant based or dietary supplements.

## Dietary calcium supplements

Calcium supplements are used to prevent and to treat calcium deficiencies. There are conflicting recommendations about when to take calcium supplements. However, most experts agree that no more than 500 mg should be taken at a time because the percent of calcium absorbed decreases as the amount of calcium in the supplement increases. It is recommended to spread doses throughout the day, with the last dose near bedtime. Recommended daily calcium intake varies from 1000 to 1500 mg, depending upon the stage of life.

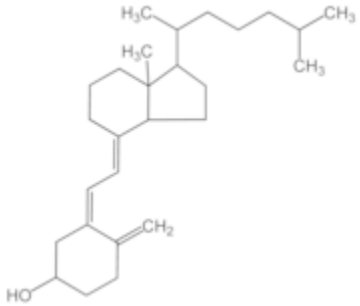
In July 2006, a report citing research from Fred Hutchinson Cancer Research Center in Seattle, Washington claimed that women in their 50's gained 5 pounds less in a period of 10 years by taking more than 500 mg of calcium supplements than those who did not. However, the doctor in charge of the study, Dr. Alejandro J. Gonzalez also noted it would be stretching it to suggest calcium supplements as a weight-limiting aid.

- Calcium carbonate is the most common and least expensive calcium supplement. It can be difficult to digest and causes gas in some people. Taking magnesium with it can help to prevent constipation. Calcium carbonate is 40% elemental calcium. 1000 mg will provide 400 mg of calcium. It is recommended to take this supplement with food to aid in absorption. In some calcium supplements based on calcium carbonate, vitamin D is added to aid in absorption. Vitamin D is needed

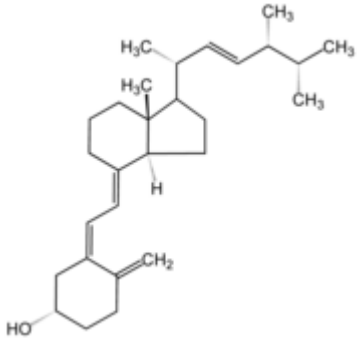
for the absorption of calcium from the stomach and for the functioning of calcium in the body.

- Calcium citrate is more easily absorbed (bioavailability is 2.5 times higher than calcium carbonate), easier to digest and less likely to cause constipation and gas than calcium carbonate. It also has a lower risk of contributing to the formation of kidney stones. Calcium citrate is about 21% elemental calcium. 1000 mg will provide 210 mg of calcium. It is more expensive than calcium carbonate and more of it must be taken to get the same amount of calcium.
- Calcium phosphate costs more than calcium carbonate, but less than calcium citrate. It is easily absorbed and is less likely to cause constipation and gas than either.
- Calcium lactate and calcium aspartate are both more easily digested, but more expensive than calcium carbonate

# Vitamin D



Cholecalciferol ($D_3$)



Ergocalciferol ($D_2$)

**Vitamin D** (also known as **calciferol**) is a hormone precursor that contributes to the maintenance of normal levels of calcium and phosphorus in the blood. Vitamin D is not a true vitamin since human skin can create vitamin D in some circumstances; it may be better described as a *conditional* vitamin.

## Overview

Vitamin D plays an important role in the maintenance of an intact and strong skeleton. Its primary task seems today to be to regulate the amount of calcium and phosphorus in the blood by ensuring correct intake from intestines and secretion. However, other related tasks are still under investigation.

Several studies show that vitamin D also regulates the growth of skin cells. Psoriasis gives shell-like skin as a result of uncontrolled cell growth. A synthetic vitamin D analogue called calcipotriene is used in the treatment of this disease.

The human body produces its own vitamin D in the skin - this is done by activating some chemicals in the body. This process is dependent on ultraviolet radiation from sunlight. Diet is a secondary source of vitamin D, but foods such as oily fish and eggs contain only very small amounts. It is almost impossible to obtain sufficient amounts of vitamin D from diet alone, without sunlight exposure or supplementation.

# Forms

- **Vitamin $D_1$**: molecular compound of ergocalciferol with lumisterol, 1:1
- **Vitamin $D_2$**: ergocalciferol or calciferol (made from ergosterol)
- **Vitamin $D_3$**: cholecalciferol (made from 7-dehydrocholesterol). Cholecalciferol is the precursor of calcidiol, which in turn is the precursor of calcitriol
- **Vitamin $D_4$**: 22,23-dihydroergocalciferol
- **Vitamin $D_5$**: sitocalciferol (made from 7-dehydrositosterol)

Vitamin $D_3$, also known as cholecalciferol, is a form of vitamin D that is made by the human body. It is made in the skin when 7-dehydrocholesterol reacts with UVB ultraviolet light with wavelengths 290 to 315 nm. This can be found in sunlight when the sun is high enough above the horizon for UVB to penetrate the atmosphere and is responsible for the production of cholecalciferol. Up to 20,000 IU can be made in the skin only after one minimal erythemal dose of exposure, or until the skin just begins to turn pink. A biological feedback mechanism prevents excessive synthesis of vitamin D from prolonged sun exposure.

Vitamin $D_2$ is derived by irradiating fungi to produce ergocalciferol. Ergocalciferol does not naturally occur in the human body unless it is added by supplementation. In humans, $D_3$ is more effective than $D_2$ at increasing 25-hydroxyvitamin D, the circulating reservoir of the vitamin D hormone. In the rat, $D_2$ is more effective as a vitamin than $D_3$, and in the squirrel monkey and the chick, $D_3$ is more effective.

In certain parts of the world, particularly at higher latitudes, total vitamin D input is usually not sufficient, especially in the winter, thus the recent concern about widespread vitamin D deficiency. To help prevent this, foods such as milk may be fortified with vitamin $D_2$ or vitamin $D_3$, typically giving 100 IU per glass.

Cholecalciferol is transported to the liver where it is hydroxylated to calcidiol or 25-hydroxy-vitamin D, the form of the vitamin that the body stores. A blood calcidiol level

is the only way to determine vitamin D deficiency; levels should be between 40 and 60 ng/mL (100 to 150 nMol/L) for optimal health.

The most active form of the vitamin is calcitriol (1,25 dihydroxy vitamin $D_3$), a potent hormone. Calcitriol is synthesized from calcidiol in the kidneys to perform its endocrine function of maintaining the calcium economy. Calcitriol binds to a transcription factor which then regulates gene expression of transport proteins like TRPV6 and calbindin that are involved in calcium absorption in the intestine. The general result is the maintenance of calcium and phosphorus levels in the bone and blood with the assistance of parathyroid hormone and calcitonin.

A number of tissues throughout the human body also have the ability to make and regulate their own calcitriol. It is these autocrine and paracrine functions of the vitamin D system that may explain its association with a host of chronic diseases.

## What is it: vitamin, steroid or secosteroid?

Strictly speaking, vitamin D is not a true vitamin, because it can be manufactured by the body. For historical reasons, however, it is generally called a vitamin. The use of the term "vitamin" leads consumers to believe they require it in their diet and that it is generally safe. Alternatively, seeing vitamin D as a steroid or secosteroid implies a powerful role, as found with steroid hormones and drugs, and calls for a closer examination of the implications of its supplementation.

Biochemically, the various forms of vitamin D, including calcidiol (25D) and calcitriol (1,25D) are secosteroids. Secosteroids are very similar in structure to steroids except that two of the ring carbon atoms (C9 and 10) of the typical four steroid rings are not fused in secosteroids, whereas in steroids they are fused. This structual similarity suggests that vitamin D can bind to some of the same receptors to which steroids bind. And in fact, molecular modeling calculations confirm that vitamin D has a high affinity for several steroid receptors, including glucocorticoid and thyroid receptors.

In May 2006, Professor Ronald M. Evans, a Fellow of the Salk Institute, delivered a continuing medical education seminar to FDA's Center for Drug Evaluation and Research. In response to a question of what the impact on public health policy should be, given that "vitamin D" is actually a secosteroid, rather than a vitamin, he indicated that he would not supplement with "vitamin D" in the food chain. This position is also supported

by new evidence that vitamin D supplementation is harmful in many chronic autoimmune diseases (see section on "In Chronic Disease" below), and not just those previously identified (sarcoidosis, granulomatous malignancy such as lymphoma, oat-cell lung cancer, or when cancer has spread to the bone).

Thus, based on its activity, vitamin D is most accurately viewed as a secosteroid with a high degree of steroidal activity. This indicates the need for further investigation of whether vitamin D supplementation is generally beneficial.

# In food

Fortified foods are the major dietary sources of vitamin D. Prior to the fortification of milk products with vitamin D in the 1930s, rickets, commonly caused by vitamin D deficiency, was a major public health problem. In the United States milk is fortified with 10 micrograms (400 IU) of vitamin D per quart, and rickets is now uncommon there.

One cup of vitamin D fortified milk supplies about one-fourth of the official estimated adequate intake of vitamin for adults older than age 50 years. Although milk is often fortified with vitamin D, dairy products made from milk (cheese, yogurt, ice cream, and so forth) are generally not. Only a few foods naturally contain significant amounts of vitamin D, including:

- Shiitake mushrooms, one of a few natural sources of vegan and kosher vitamin D (vitamin D2),
- Fish liver oils, such as cod liver oil, 1 Tbs. (15 ml), 1,360 IU (340% Daily value)
- Fatty fish, such as:
    - Salmon, cooked, 3.5 oz, 360 IU (90% DV)
    - Mackerel, cooked, 3.5 oz, 345 IU (90% DV)
    - Sardines, canned in oil, drained, 1.75 oz, 250 IU (70% DV)
    - Tuna, canned in oil, 3 oz, 200 IU (50% DV)
    - Eel, cooked, 3.5 oz, 200 IU
- One whole egg, 20 IU (6% DV)

Vitamin D is commonly measured in micrograms (mcg). However, International Units (IU) is the unit of measurement for vitamin D that appears on food labels.

# Nutrition

The U.S. Dietary Reference Intake (DRI) for an Adequate Intake (AI) for a 25-year old male for vitamin D is 5 micrograms/day (200 units/day). This rises to 15 micrograms/day (600 units/day) at age 70.

## Diseases caused by deficiency

Vitamin D deficiency is known to cause several bone diseases, due to insufficient calcium or phosphate in the bones:

- Rickets: a childhood disease characterized by failure of growth and deformity of long bones.
- Osteoporosis: a condition characterized by fragile bones.
- Osteomalacia: a bone-thinning disorder in adults that is characterised by proximal muscle weakness and bone fragility. Osteomalacia can only occur in a mature skeleton.

Pioneering work in isolating vitamin D and determining its role in rickets was done by Edward Mellanby in 1918–1920. The 1928 Nobel Prize was awarded to Adolf Windaus, who discovered the steroid, 7-dehydrocholesterol, the precursor of vitamin D. Vitamin D deficiency has been said to be endemic in dark-skinned races living in high latitudes (see below).

Vitamin D malnutrition may possibly be linked to chronic diseases such as cancer (breast, ovarian, colon, prostate, lung and skin and probably a dozen more types), chronic pain, weakness, chronic fatigue, autoimmune diseases like multiple sclerosis and Type 1 diabetes, high blood pressure, mental illnesses (depression, seasonal affective disorder and possibly schizophrenia) heart disease, rheumatoid arthritis, psoriasis, tuberculosis, periodontal disease and inflammatory bowel disease.

However, recent research indicates that in many chronic diseases where vitamin D levels (25 hydroxyvitamin D) appear to be low, vitamin D supplementation can actually cause long term harm. For example, supplementation with vitamin D is potentially hazardous for those with sarcoidosis and other diseases involving vitamin D hypersensitivity and dysregulation. There is increasing evidence for similar vitamin D hypersensitivity and dysregulation in a wide variety of autoimmune diseases, including rheumatoid arthritis and inflammatory bowel disease. Waterhouse et al reports vitamin D may appear to be low in these conditions, but only because it is being energetically converted to its active hormonal form (1,25 dihydroxyvitamin D) by disease processes.

**Groups at greater risk**

Older people (age 50 and over) have a higher risk of developing vitamin D deficiency. The ability of skin to convert 7-dehydrocholesterol to pre-vitamin $D_3$ is decreased in older people. The kidneys, which help convert calcidiol to its active form, sometimes do not work as well when people age. Therefore, many older people may need vitamin D supplementation.

Newborn infants who are exclusively breastfed may require vitamin D supplements. Breast milk does not contain significant levels of the vitamin, and although infants could receive this vitamin from sunlight, it is usually not recommended that small infants be exposed to sunlight in the levels required to produce a sufficient amount of vitamin D. Infant formula is generally fortified with vitamin D, so this requirement only applies to breastfed infants.

Dark-skinned people living at higher latitudes may require extra vitamin D because their high level of skin pigmentation generally retards the absorption of UV rays. This does not pose a problem in tropical areas, where the amount of sunshine is so high that enough vitamin D is produced despite the dark skin color. At higher latitudes, however, the decreased angle of the sun's rays, reduced daylight hours in winter, and protective clothing worn to guard against cold weather prove detrimental to the absorption of sunlight and the production of vitamin D. Light-skinned people at higher latitudes also face these problems, but the lower amount of pigmentation in their skin allows more sunlight to be absorbed, thereby reducing the risk of vitamin D deficiency (conversely, light-skinned people are disadvantaged in the tropics, as they are more susceptible than dark-skinned people to intense sunlight and resultant problems such as sunburn and melanoma).

There is also evidence that obese people have lower levels of the circulating form of vitamin D, probably because it is deposited in body fat compartments and is less bioavailable, so obese people whose vitamin D production and intake is marginal or inadequate are at higher risk of deficiency.

Those who avoid or are not exposed to summer midday sunshine may also require vitamin D supplements. In particular, recent studies have shown Australians and New Zealanders are vitamin D deficient, particularly after the successful "Slip-Slop-Slap" health campaign encouraging Australians to cover up when exposed to sunlight to

prevent skin cancer. Ironically, a vitamin D deficiency may also lead to skin cancer. Still, only a few minutes of exposure (probably 6 times more in dark-skinned people) is all that is required; the production is very rapid. However, since even a few minutes of unprotected ultraviolet exposure a day increases the risk of skin cancer and causes photoaging of the skin, many dermatologists recommend supplementation of vitamin D and daily sunscreen use.

Adults taking vitamin D in vitamin pills containing 5 micrograms (200 IU) per day are not protected against vitamin D deficiency — even though 200 IU/day is the adequate intake officially recommended up to age 50 years. Currently, the general public is advised that the safety of vitamin D intake cannot be assured beyond 50 micrograms/day (2000 IU/day). Despite a widespread recognition that current official advice to the public about vitamin D is out of date, the process for revising recommendations like the RDA has stopped, apparently for budgetary reasons. Vitamin D dietary guidelines are among the next in line for reassessment by the Food and Nutrition Board in North America.[*citation needed*]

Patients with chronic liver disease or intestinal malabsorption may require larger doses of vitamin D (up to 40,000 IU or 1 mg (1000 micrograms) daily). To maintain blood levels of calcium, therapeutic vitamin D doses are sometimes administered (up to 100,000 IU or 2.5 mg daily) to patients who have had their parathyroid glands removed (most commonly renal dialysis patients who have had tertiary hyperparathyroidism, but also patients with primary hyperparathyroidism) or who suffer with hypoparathyroidism. Long-term intake of these doses would be toxic in normal human beings.

## Oral overdose

The U.S. Dietary Reference Intake Tolerable Upper Intake Level (UL) for a 25-year old male for vitamin D is 50 micrograms/day. This is equivalent to 2000 IU/day.

Overdose is extremely rare; in fact, mild deficiencies are far more common. While the sunshine-generated quantity is self-limiting, vitamin pills were thought not to be; and this has led to widespread concern, which may well be misplaced.

In practice, the human body has enormous storage capacity for vitamin D, and in any case all common foods and correctly-formulated vitamin pills contain far too little for overdose to ever occur in normal circumstances and normal doses.[*citation needed*] Indeed,

Stoss therapy involves taking a dose over a thousand times the daily RDA once every few months, and even then often fails to normalise vitamin $D_3$ levels in the body.[*citation needed*] However, oral overdose *has* been recorded due to manufacturing and industrial accidents and leads to hypercalcaemia and atherosclerosis and ultimately death. In rodents, the hypercalcaemia effect of vitamin D leads to a highly effective rat poison.

The exact long-term safe dose is not entirely known, but intakes of up to 2000 IU (10x the RDA) are believed to be safe, and some researchers believe that 10,000 IU does not lead to long term overdose. It seems that there are chemical processes that destroy excess vitamin D, even when taken orally, although these processes have not been identified (in experiments blood levels of vitamin D do not continue to increase over many months at these doses as presumably would be needed for toxicity to occur.)

Note that although normal food and pill vitamin D concentration levels are too low to be toxic, cod-liver oil, if taken in multiples of the normal dose, could reach poisonous levels because of the high vitamin A content in cod-liver oil — not the vitamin D.

Other research disputes the view that high vitamin D intake is so benign. In one study, hypercalciuria and bone loss occurred at levels of 25D above approximately 50 ng/ml. Another study showed elevated risk of ischaemic heart disease when 25D was above 89 ng/ml. In many chronic diseases, new research indicates vitamin D supplementation is inadvisable due to vitamin D hypersensitivity and dysregulation.

## In cancer prevention and recovery

Recent research suggests that cancer patients who have their surgery or treatment in the summer — and therefore get more vitamin D — have a much better chance of surviving the disease than those who have their treatment in the winter when they are exposed to less sunlight.

In 2005, U.S. scientists released a study, published in the American Journal of Public Health, which seems to demonstrate a beneficial corelation between vitamin D intake and prevention of cancer. Drawing from their review of 63 old studies, the scientists claimed that taking 1,000 international units (IU) — or 25 micrograms — of the vitamin daily could lower an individual's cancer risk by 50% in colon cancer, and by 30% in breast and ovarian cancer. Cancer experts, however, say that much further research is needed to provide concrete proof about vitamin D's ability to prevent cancer.

David Feldman's group at Stanford University has elucidated some of the ways that vitamin D, naproxen, and soy prevent and may serve as a therapy for prostate cancer.

## In chronic disease

There is increasing recognition that Th1 immune inflammation, occurring in rheumatic diseases can result in excessive numbers of activated macrophages converting 25-hydroxyvitamin D (25D) to its active 1,25 dihydroxyvitamin D (1,25D) hormonal form. This can lead to vitamin D dysregulation/hypersensitivity, which can lead to hypervitaminosis D, hypercalcemia and other symptoms. This is recognized as occurring in sarcoidosis and other diseases.

Serum vitamin D, measured by the precursor, 25D, may appear to be deficient in chronic diseases in which vitamin D dysregulation occurs, because it is being depleted due to excessive conversion into the active 1,25D form by macrophages. In this situation, supplementation with vitamin D may lead to an even greater elevation of an already elevated level of the 1,25D hormone. Marshall showed that elevated levels of 1,25D are able to cause dysfunction of alpha 2 thyroid receptors and glucocorticoid receptors, thus interfering with endocrine function and the adaptive immune response.

Some of the newest research on vitamin D emphasizes its role in combating viruses and bacteria, including tiny L-form bacteria, named after the Lister Institute where they were first described by Kleinberger-Nobel in 1934. L-forms lack a cell wall and can hide inside cells, including immune cells, like macrophages. There is increasing evidence for this in diseases like systemic lupus erythematosus, rheumatoid arthritis, Crohn's disease, sarcoidosis and multiple sclerosis.

Molecular modeling research indicates that when 25D is high enough, it actually displaces 1,25D bound to the vitamin D receptor (VDR). This may block innate immunity and bacterial killing, thus suppressing the reaction associated with bacterial killing, called the Jarisch-Herxheimer Reaction. This anti inflammatory effect may explain why some studies find that vitamin D gives the appearance of being helpful in the short term. However, if bacteria are the underlying cause of the disease, this suppression of the inflammatory innate immune response may allow bacteria to increase and cause harm occurring over several decades. This immunosuppressive effect of vitamin D, as well as other effects, are similar to the effect of steroid drugs and, in fact, it is

questionable whether vitamin D should continue to be regarded as a vitamin (see section "What is it?" above).

The success of a new antibacterial protocol (Autoimmunity Research Foundation) that includes lowering of vitamin D levels, supports the importance of vitamin D dysregulation in many chronic diseases. The role of vitamin D and the vitamin D receptor (VDR) is also shown by the effectiveness of olmesartan, an angiotensin receptor blocker, as part of this new protocol. Olmesartan acts through binding to the VDR, among other effects.

This new research on vitamin D's effects and the role of vitamin D dysregulation may require reinterpretation of much past research supporting vitamin D supplementation in the prevention and treatment of many chronic diseases.

# In human skin

Vitamin $D_3$ is produced in the skin by conversion of 7-dehydrocholesterol by UVB. Human skin exposed to sunlight can, under the right conditions, produce quantities as large as 20,000 IU in just a few minutes without any apparent toxicity. This is easily enough to avoid deficiency and builds up the body's stores.

Exposure to sunlight also destroys vitamin D, so long term exposure to sunlight cannot cause toxicity, as levels are self-adjusting.

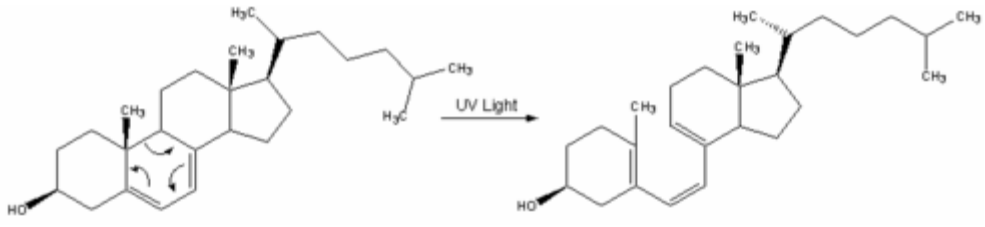
However merely being exposed to sunlight does not automatically mean that vitamin D is produced, only the UVB in sunlight triggers vitamin D production, but UVB mainly reaches ground level when the sun is high in the sky. This occurs a few hours around solar midday (1 p.m. summertime). At higher latitudes, the sun is only high enough in the sky in summer. For example, in the United States, those living north of a line from San Francisco to Philadelphia (about 40 degrees of latitude) will not be able to produce it in significant quantities for 3 to 6 months a year.

Therefore from the end of summertime to the following spring humans run on stores which gradually deplete. By some estimates 10–20% of the population become at least mildly deficient by the end of winter, and deficiency is high even in very sunny countries like India. People who never go out in the midday sun become deficient even on supplementation at 100% of the RDA.

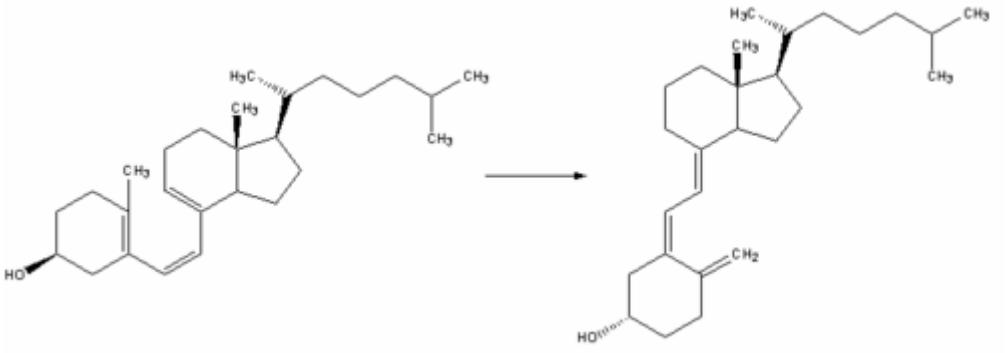
In addition, suntan lotion blocks production. Deficiencies are now much more common in Australia, which had a very successful "slip slop slap" campaign, though most of the deficient people have dark skin, cover up when outdoors or are confined indoors (for example: elderly people or those with a disability or serious illness). This campaign has also taken place in New Zealand. Melanin screens UVB light so dark skin is much less efficient at generating vitamin D. It would therefore be expected that people with darker skin would suffer from deficiencies more frequently, especially if they live at higher latitudes or have an urban lifestyle, and there is much evidence that this is the case. Vitamin D deficiency and osteomalacia are known to be endemic in dark-skinned populations in the UK (particularly those from South Asia).

## Synthesis mechanism (form 3)

1. Vitamin $D_3$ is synthesized from 7-dehydrocholesterol, a derivative of cholesterol, which is then photolyzed by ultraviolet light in 6-electron conrotatory electrocyclic reaction. The product is *pre-vitamin $D_3$*.




2. Pre-vitamin $D_3$ then spontaneously isomerizes to Vitamin $D_3$ in a antarafacial hydride [1,7]Sigmatropic shift.



3. Vitamin $D_3$ (cholecalciferol) is then hydroxylated in the liver to 25-hydroxycholecalciferol (calcidiol) and stored until it is needed. 25-hydroxycholecalciferol is further hydroxylated in the kidneys to the main

biologically active form 1,25-dihydroxycholecalciferol (calcitriol) in a tightly regulated fashion. Calcitriol is represented below right (hydroxilated Carbon 1 is on the lower ring at right, hydroxylated Carbon 25 is at the upper right end).

# Phosphorus

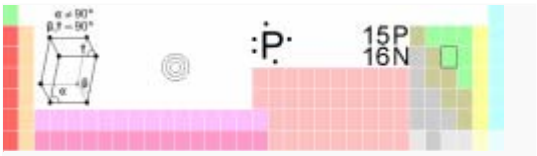
**Phosphorus**, (IPA: / f sfərəs/, Greek: *phôs* meaning "light", and *phoros* meaning "bearer"), is the chemical element in the periodic table that has the symbol **P** and atomic number 15. A multivalent nonmetal of the nitrogen group, phosphorus is commonly found in inorganic phosphate rocks and in all living cells.

Phosphorus exists in several allotropes, most commonly white, red and black. White phosphorus ($P_4$) contains only four atoms, resulting in very high ring strain and instability. White phosphorus glows in the dark, is highly flammable and pyrophoric (self-igniting) upon contact with air as well as toxic. Red phosphorus has a network form which reduces strain and gives greater stability. Red phosphorus does not catch fire in air at temperatures below 240°C whereas white phosphorus ignites at about 40°C. Black phosphorus is amorphous and is the least reactive allotrope.

Due to its high reactivity, phosphorus is never found as a free element in nature. It emits a faint glow upon exposure to oxygen (hence its Greek derivation and the Latin meaning 'morning star') and is an essential element for living organisms. The most important commercial use of phosphorus-based chemicals is the production of fertilizers. They are also widely used in explosives, nerve agents,

**15** silicon ← phosphorus → sulfur

N
↑
**P**
↓
As




Periodic Table - Extended Periodic Table

| **General** | |
|---|---|
| Name, Symbol, Number | phosphorus, P, 15 |
| Chemical series | nonmetals |
| Group, Period, Block | 15, 3, p |
| Appearance | waxy white/ red/ black/ colorless  |
| Atomic mass | 30.973762(2) g/mol |
| Electron configuration | [Ne] $3s^2$ $3p^3$ |
| Electrons per shell | 2, 8, 5 |
| **Physical properties** | |
| Phase | solid |
| Density (near r.t.) | (white) 1.823 g·cm$^{-3}$ |
| Density (near r.t.) | (red) 2.34 g·cm$^{-3}$ |
| Density (near r.t.) | (black) 2.69 g·cm$^{-3}$ |
| Melting point | (white) 317.3 K (44.2 °C, 111.6 °F) |
| Boiling point | 550 K (277 °C, 531 °F) |
| Critical temperature | 994 K |
| Heat of fusion | (white) 0.66 kJ·mol$^{-1}$ |
| Heat of vaporization | 12.4 kJ·mol$^{-1}$ |
| Heat capacity | (25 °C) (white) 23.824 J·mol$^{-1}$·K$^{-1}$ |

Vapor pressure (white)

| *P*/Pa | 1 | 10 | 100 | 1 k | 10 k | 100 k |
|---|---|---|---|---|---|---|
| at *T*/K | 279 | 307 | 342 | 388 | 453 | 549 |

Vapor pressure (red)

| *P*/Pa | 1 | 10 | 100 | 1 k | 10 k | 100 k |
|---|---|---|---|---|---|---|
| at *T*/K | 455 | 489 | 529 | 576 | 635 | 704 |

| **Atomic properties** | |
|---|---|

friction matches, fireworks, pesticides, toothpaste, and detergents.

# Characteristics

Phosphorus, in its common form, is a waxy white (or yellowish) solid that has a characteristic, disagreeable smell similar to that of garlic. Pure forms of the element are colorless and transparent. This nonmetal is not soluble in water, but *is* soluble in carbon disulfide. Pure phosphorus ignites spontaneously in air, burning to produce phosphorus pentoxide.

### Glow

The glow from phosphorus was the attraction of its discovery around 1669, but the mechanism for that glow was not fully described until 1974. It was known from early times that the glow would persist for a time in a stoppered jar but then cease. Robert Boyle in the 1680s ascribed it to "debilitation" of the air. In fact it is oxygen being consumed. By the 18th century it was known that in pure oxygen phosphorus does not glow at all, there is only a range of partial pressure where it does, too high or too low and the reaction stops. Heat can be applied to drive the reaction at higher pressures.

In 1974 the glow was explained by R. J. van Zee and A. U. Khan. A reaction with oxygen takes place at the surface of the solid (or liquid) phosphorus, forming short-lived molecules HPO and $P_2O_2$ and they both emit visible light. The reaction is slow and only very little of the intermediates is required to produce the luminescence, hence the extended time the glow continues in a stoppered jar.

Although the term phosphorescence is derived from phosphorus, the reaction is properly called luminescence (glowing by its own reaction, in this case chemoluminescence), not phosphorescence (re-emitting light that previously fell on it).

# Applications

Concentrated phosphoric acids, which can consist of 70% to 75% $P_2O_5$ are very important to agriculture and farm production in the form of fertilizers. Global demand for fertilizers led to large increases in phosphate ($PO_4^{3-}$) production in the second half of the 20th century. Other uses;

- Phosphates are utilized in the making of special glasses that are used for sodium lamps.
- Bone-ash, calcium phosphate, is used in the production of fine china.
- Sodium tripolyphosphate made from phosphoric acid is used in laundry detergents in several countries, and banned for this use in others.
- Phosphoric acid made from elementary phosphorus is used in food applications such as soda beverages. The acid is also a starting point to make food grade phosphates. These include mono-calcium phosphate which is employed in baking powder and sodium tripolyphosphate and other sodium phosphates. Among other uses, these are used to improve the characteristics of processed meat and cheese. Others are used in toothpaste. Trisodium phosphate is used in cleaning agents to soften water and for preventing pipe/boiler tube corrosion.
- Phosphorus is widely used to make organophosphorus compounds, through the intermediates phosphorus chlorides and the two phosphorus sulfides: phosphorus pentasulfide, and phosphorus sesquisulfide. Organophosphorus compounds have many applications, including in plasticizers, flame retardants, pesticides, extraction agents, and water treatment.
- Phosphorus sesquisulfide is used in heads of strike-anywhere matches.
- Phosphorus is also an important component in steel production, in the making of phosphor bronze, and in many other related products.
- White phosphorus is used in military applications as incendiary bombs, for smoke-screening as smoke pots and smoke bombs, and in tracer ammunition.
- Red phosphorus is essential for manufacturing matchbook strikers, flares,, safety matches and, most notoriously, methamphetamine.
- In trace amounts, phosphorus is used as a dopant for N-type semiconductors.
- $^{32}P$ and $^{33}P$ are used as radioactive tracers in biochemical laboratories (see Isotopes).
- Red phosphorus is used in cap guns.

# Biological role

Phosphorus is a key element in all known forms of life. Inorganic phosphorus in the form of the phosphate $PO_4^{3-}$ plays a major role in biological molecules such as DNA and RNA where it forms part of the structural framework of these molecules. Living cells also utilize phosphate to transport cellular energy via adenosine triphosphate (ATP). Nearly every cellular process that uses energy gets it in the form of ATP. ATP is also important for phosphorylation, a key regulatory event in cells. Phospholipids are the main structural components of all cellular membranes. Calcium phosphate salts are used by animals to stiffen their bones. An average person contains a little less than 1 kg of phosphorus, about three quarters of which is present in bones and teeth in the form of apatite. A well-fed adult in the industrialized world consumes and excretes about 1-3 g of phosphorus per day in the form of phosphate. Phosphorus is an essential mineral macronutrient, which is

studied extensively in soil conservation in order to understand plant uptake from soil systems.

In ecological terms, phosphorus is often a limiting nutrient in many environments, i.e. the availability of phosphorus governs the rate of growth of many organisms. In ecosystems an excess of phosphorus can be problematic, especially in aquatic systems, see eutrophication and algal blooms.

# History

Phosphorus (Greek *phosphoros* was the ancient name for the planet Venus) was discovered by German alchemist Hennig Brand in 1669 through a preparation from urine. Working in Hamburg, Brand attempted to distill salts by evaporating urine, and in the process produced a white material that glowed in the dark and burned brilliantly. Since that time, phosphorescence has been used to describe substances that shine in the dark without burning.

Phosphorus was first made commercially, for the match industry, in the 19th century, by distilling off phosphorus vapour from precipitated phosphates heated in a retort The precipitated phosphates were made from ground-up bones that had been de-greased and treated with strong acids. This process became obsolete in the late 1890s when the electric arc furnace was adapted to reduce phosphate rock.

Early matches used white phosphorus in their composition, which was dangerous due to its toxicity. Murders, suicides and accidental poisonings resulted from its use. (An apocryphal tale tells of a woman attempting to murder her husband with white phosphorus in his food, which was detected by the stew giving off luminous steam). In addition, exposure to the vapors gave match workers a necrosis of the bones of the jaw, the infamous "phossy jaw." When a safe process for manufacturing red phosphorus was discovered, with its far lower flammability and toxicity, laws were enacted, under a Berne Convention, requiring its adoption as a safer alternative for match manufacture.

The electric furnace method allowed production to increase to the point phosphorus could be used in weapons of war. In World War I it was used in incendiaries, smoke screens and tracer bullets. A special incendiary bullet was developed to shoot at hydrogen filled Zeppelins over Britain (hydrogen of course being highly flammable if it can be ignited). During World War II Molotov cocktails of benzene and phosphorus were distributed in

Britain to specially selected civilians within the British Resistance Operation, for defence; and phosphorus incendiary bombs were used in War on a large scale. Burning phosphorus is difficult to extinguish and if it splashes onto human skin it has horrific effects (see precautions below). People covered in it were known to commit suicide due to the torment.

Today phosphorus production is larger than ever, used as a precursor for various chemicals, in particular the herbicide glyphosate sold under the brand name Roundup. Production of white phosphorus takes place at large facilities and is transported heated in liquid form. Some major accidents have occurred during transportation, train derailments at Brownston, Nebraska and Miamisburg, Ohio lead to large fires. The worst accident in recent times though was an environmental one in 1968 when phosphorus spilt into the sea from a plant at Placentia Bay, Newfoundland.

# Occurrence

Due to its reactivity to air and many other oxygen containing substances, phosphorus is not found free in nature but it is widely distributed in many different minerals. Phosphate rock, which is partially made of apatite (an impure tri-calcium phosphate mineral), is an important commercial source of this element. Large deposits of apatite are located in China, Russia, Morocco, Florida, Idaho, Tennessee, Utah, and elsewhere. Albright and Wilson in the United Kingdom and their Niagara Falls plant, for instance, were using phosphate rock in the 1890s and 1900s from Connetable, Tennessee and Florida; however, by 1950 they were using phosphate rock mainly from Tennessee and North Africa. In the early 1990s Albright and Wilson's purified wet phosphoric acid business was being affected by phosphate rock sales by China and the entry of their long standing Moroccan phosphate suppliers into the purified wet phosphoric acid business.

The white allotrope can be produced using several different methods. In one process, tri-calcium phosphate, which is derived from phosphate rock, is heated in an electric or fuel-fired furnace in the presence of carbon and silica. Elemental phosphorus is then liberated as a vapor and can be collected under phosphoric acid.

*Phosphate minerals.*

# Precautions

Organic compounds of phosphorus form a wide class of materials, some of which are extremely toxic. Fluorophosphate esters are among the most potent neurotoxins known. A wide range of organophosphorus compounds are used for their toxicity to certain organisms as pesticides (herbicides, insecticides, fungicides etc) and weaponized as nerve agents. Most inorganic phosphates are relatively nontoxic and essential nutrients. For environmentally adverse effects of phosphates see eutrophication and algal blooms.

The allotrope white phosphorus should be kept under water at all times as it presents a significant fire hazard due to its extreme reactivity to atmospheric oxygen, and it should only be manipulated with forceps since contact with skin can cause severe burns. Chronic white phosphorus poisoning of unprotected workers leads to necrosis of the jaw called "phossy-jaw". Ingestion of white phosphorus may cause a medical condition known as "Smoking Stool Syndrome".

When the white form is exposed to sunlight or when it is heated in its own vapor to 250°C, it is transmuted to the red form, which does not phosphoresce in air. The red allotrope does not spontaneously ignite in air and is not as dangerous as the white form. Nevertheless, it should be handled with care because it does revert to white phosphorus in some temperature ranges and it also emits highly toxic fumes that consist of phosphorus oxides when it is heated.

Upon exposure to elemental phosphorus, in the past it was suggested to wash the affected area with 2% copper sulfate solution to form harmless compounds that can be washed away. According to the recent *US Navy's Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries: FM8-285: Part 2 Conventional Military Chemical Injuries*, "Cupric (copper) sulfate has been used by U.S. personnel in the past and is still being used by some nations. However, copper sulfate is toxic and its use will be discontinued. Copper sulfate may produce kidney and cerebral toxicity as well as intravascular hemolysis."

The manual suggests instead "a bicarbonate solution to neutralize phosphoric acid, which will then allow removal of visible WP. Particles often can be located by their emission of smoke when air strikes them, or by their phosphorescence in the dark. In dark surroundings, fragments are seen as luminescent spots." Then, "Promptly debride the burn if the patient's condition will permit removal of bits of WP which might be absorbed later and possibly produce systemic poisoning. DO NOT apply oily-based ointments until it is certain that all WP has been removed. Following complete removal of the particles, treat the lesions as thermal burns." As white phosphorus readily mixes with oils, any oily substances or ointments are disrecommended until the area is thoroughly cleaned and all white phosphorus removed.

# Isotopes

sRadioactive isotopes of phosphorus include:

- $^{32}P$; a beta-emitter (1.71 MeV) with a half-life of 14.3 days which is used routinely in life-science laboratories, primarily to produce radiolabeled DNA and RNA probes, *e.g.* for use in Northern blots or Southern blots. Because the high energy beta particles produced penetrate skin and corneas, and because any $^{32}P$ ingested, inhaled, or absorbed is readily incorporated into bone and nucleic acids, OSHA requires that a lab coat, disposable gloves, and safety glasses or goggles be worn when working with $^{32}P$, and that working directly over an open container be avoided in order to protect the eyes. Monitoring personal, clothing, and surface contamination is also required. In addition, due to the high energy of the beta particles, shielding this radiation with the normally used dense materials (*e.g.* lead), gives rise to secondary emission of X-rays via a process known as Bremsstrahlung, meaning braking radiation. Therefore shielding must be accomplished with low density materials, *e.g.* Plexiglas, acrylic, Lucite, plastic, wood, or water.
- $^{33}P$; a beta-emitter (0.25 MeV) with a half-life of 25.4 days. It is used in life-science laboratories in applications in which lower energy beta emissions are advantageous such as DNA sequencing.

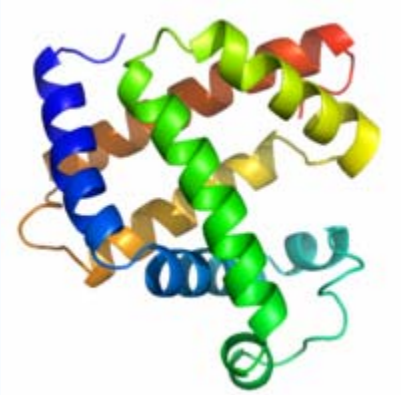
# Spelling

According to the Oxford English Dictionary the correct spelling of the element is *phosphorus*. The word *phosphorous* is the adjectival form for the $P^{3+}$ valency: so, just as sulfur forms sulfur*ous* and sulfur*ic* compounds, so phosphorus forms phosphor*ous* and phosphor*ic* compounds.

# Compounds

- Ammonium phosphate ($(NH_4)_3PO_4$)
- Calcium phosphate ($Ca_3(PO_4)_2$)
- Calcium dihydrogen phosphate ($Ca(H_2PO_4)_2$)
- Calcium phosphide ($Ca_3P_2$)
- Iron(III) phosphate ($FePO_4$)
- Iron(II) phosphate ($Fe_3(PO_4)_2$)
- Gallium(III) phosphide (GaP)
- Hypophosphorous acid ($H_3PO_2$)
- Lawesson's reagent
- Parathion
- Phosphine (Phosphorus Trihydride $PH_3$)
- Phosphoric acid ($H_3PO_4$)
- Phosphorus pentabromide ($PBr_5$)
- Phosphorus pentasulfide ($P_2S_5$)
- Phosphorus pentoxide ($P_2O_5$)
- Phosphorus sesquisulfide ($P_4S_3$)
- Phosphorus tribromide ($PBr_3$)
- Phosphorus trichloride ($PCl_3$)
- Phosphorus triiodide ($PI_3$)
- Sarin
- Soman
- Tabun
- Triphenyl phosphine
- Monopotassium phosphate ($KH_2PO_4$)
- Trisodium phosphate ($Na_3PO_4$)
- VX nerve gas

# Protein



A representation of the 3D structure of myoglobin, showing coloured alpha helices. This protein was the first to have its structure solved by X-ray crystallography.

**Proteins** are large organic compounds made of amino acids arranged in a linear chain and joined together between the carboxyl atom of one amino acid and the amine nitrogen of another. This bond is called a peptide bond. The sequence of amino acids in a protein is defined by a gene and encoded in the genetic code. Although this genetic code specifies 20 "standard" amino acids, the residues in a protein are often chemically altered in post-translational modification: either before the protein can function in the cell, or as part of control mechanisms. Proteins can also work together to achieve a particular function, and they often associate to form stable complexes.

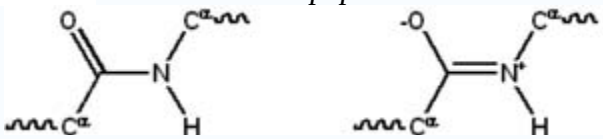
Like other biological macromolecules such as polysaccharides and nucleic acids, proteins are essential parts of all living organisms and participate in every process within cells. Many proteins are enzymes that catalyze biochemical reactions, and are vital to metabolism. Other proteins have structural or mechanical functions, such as the proteins in the cytoskeleton, which forms a system of scaffolding that maintains cell shape. Proteins are also important in cell signaling, immune responses, cell adhesion, and the cell cycle. Protein is also a necessary component in our diet, since animals can not synthesise all the amino acids and must obtain essential amino acids from food. Through the process of digestion, animals break down ingested protein into free amino acids that can be used for protein synthesis.

The name *protein* comes from the Greek *πρώτα* ("prota"), meaning "*of primary importance*" and were first described and named by Jöns Jakob Berzelius in 1838.

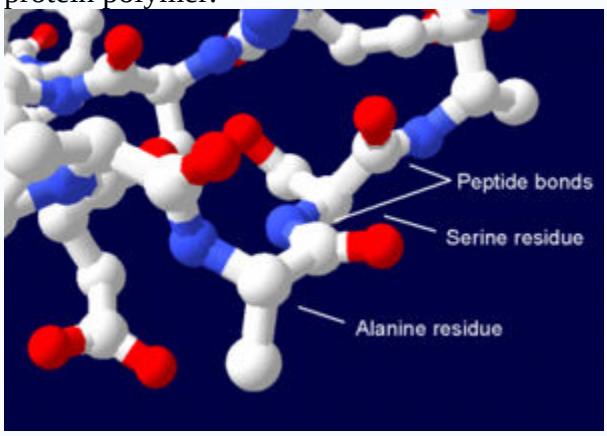
However, their central role in living organisms was not fully appreciated until 1926, when James B. Sumner showed that the enzyme urease was a protein. Only 32 years later, the first protein structure was solved, that of myoglobin by Max Perutz and Sir John Cowdery Kendrew in 1958, which led to their receiving a Nobel Prize in Chemistry.

# s Biochemistry

*Amino acid and peptide bond*




Resonance structures of the peptide bond that links individual amino acids to form a protein polymer.




Section of a protein structure showing serine and alanine residues linked together by peptide bonds. Carbons are shown in white and hydrogens are omitted for clarity.

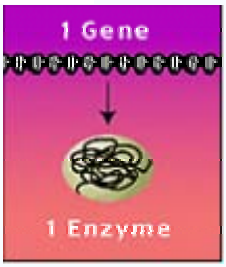
Proteins are linear polymers built from 20 different L-alpha-amino acids. All amino acids share common structural features including an alpha carbon to which an amino group, a carboxyl group, and a variable side chain are bonded. The side chains of the standard amino acids, detailed in the list of standard amino acids, have varying chemical properties that produce proteins' three-dimensional structure and are therefore critical to protein function. The amino acids in a polypeptide chain are linked by peptide bonds formed in a dehydration reaction. Once linked in the protein chain, an individual amino acid is called a *residue* and the linked series of carbon, nitrogen, and oxygen atoms are known as the *main chain* or *protein backbone*. The peptide bond has two resonance forms that contribute some double bond character and inhibit rotation around its axis, so that the alpha carbons are roughly coplanar. The other two dihedral angles in the peptide bond determine the local shape assumed by the protein backbone.

Due to the chemical structure of the individual amino acids, the protein chain has directionality. The end of the protein with a free carboxyl group is known as the C-terminus or carboxy terminus, while the end with a free amino group is known as the N-terminus or amino terminus.

There is some ambiguity between the usage of the words *protein*, *polypeptide*, and *peptide*. *Protein* is generally used to refer to the complete biological molecule in a stable conformation, while *peptide* is generally reserved for a short amino acid oligomers often lacking a stable 3-dimensional structure. However, the boundary between the two is ill-defined and usually lies near 20-30 residues. *Polypeptide* can refer to any single linear chain of amino acids, usually regardless of length, but often implies an absence of a single defined conformation.

# Synthesis

*Protein biosynthesis*




Proteins are assembled from amino acids using information encoded in genes. Each protein has its own unique amino acid sequence that is specified by the nucleotide sequence of the gene encoding this protein. The genetic code is a set of three-nucleotide sets called codons and each three-nucleotide combination stands for an amino acid, for example ATG stands for methionine. Because DNA contains four nucleotides, the total number of possible codons is 64; hence, there is some redundancy in the genetic code and some amino acids are specified by more than one codon. Genes encoded in DNA are first transcribed into pre-messenger RNA (mRNA) by proteins such as RNA polymerase. Most organisms then process the pre-mRNA (also known as a *primary transcript*) using various forms of post-transcriptional modification to form the mature mRNA, which is then used as a template for protein synthesis by the ribosome. In prokaryotes the mRNA may either be used as soon as it is produced, or be bound by a ribosome after having moved away from the nucleoid. In contrast, eukaryotes make mRNA in the cell nucleus

and then translocate it across the nuclear membrane into the cytoplasm, where protein synthesis then takes place. The rate of protein synthesis is higher in prokaryotes than eukaryotes and can reach up to 20 amino acids per second.

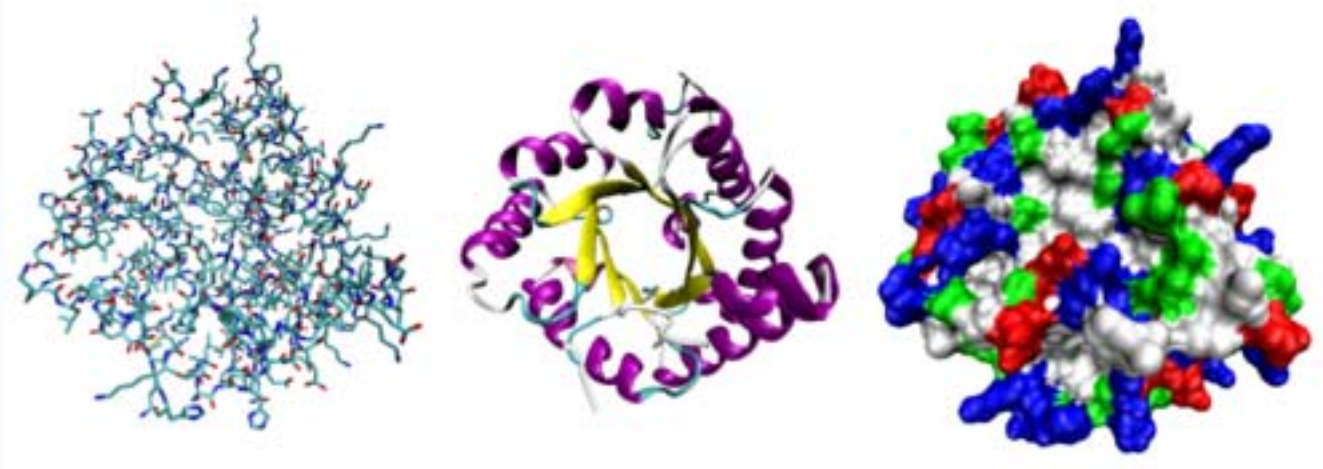
The process of synthesizing a protein from an mRNA template is known as translation. The mRNA is loaded onto the ribosome and is read three nucleotides at a time by matching each codon to its base pairing anticodon located on a transfer RNA molecule, which carries the amino acid corresponding to the codon it recognizes. The enzyme aminoacyl tRNA synthetase "charges" the tRNA molecules with the correct amino acids. The growing polypeptide is often termed the *nascent chain*. Proteins are always biosynthesized from N-terminus to C-terminus.

The size of a synthesized protein can be measured by the number of amino acids it contains and by its total molecular mass, which is normally reported in units of *daltons* (synonymous with atomic mass units), or the derivative unit kilodalton (kDa). Yeast proteins are on average 466 amino acids long and 53 kDa in mass. The largest known proteins are the titins, a component of the muscle sarcomere, with a molecular mass of almost 3,000 kDa and a total length of almost 27,000 amino acids.

### Chemical synthesis

Short proteins can also be synthesized chemically in the laboratory by a family of methods known as peptide synthesis, which rely on organic synthesis techniques such as chemical ligation to produce peptides in high yield. Chemical synthesis allows for the introduction of non-natural amino acids into polypeptide chains, such as attachment of fluorescent probes to amino acid side chains. These methods are useful in laboratory biochemistry and cell biology, though generally not for commercial applications. Chemical synthesis is inefficient for polypeptides longer than about 300 amino acids, and the synthesized proteins may not readily assume their native tertiary structure. Most chemical synthesis methods proceed from C-terminus to N-terminus, opposite the biological reaction.

## Structure of Proteins



Three possible representations of the three-dimensional structure of the protein triose phosphate isomerase. Left: all-atom representation colored by atom type. Middle: "cartoon" representation illustrating the backbone conformation, colored by secondary structure. Right: Solvent-accessible surface representation colored by residue type (acidic residues red, basic residues blue, polar residues green, nonpolar residues white).

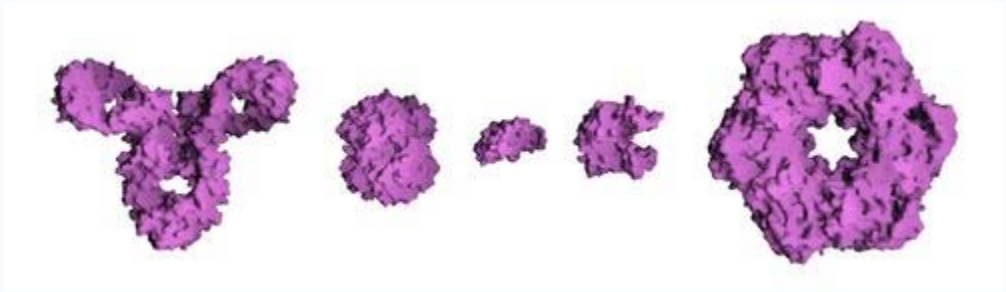
*Protein structure*

Most proteins fold into unique 3-dimensional structures. The shape into which a protein naturally folds is known as its native state. Although many proteins can fold unassisted simply through the structural propensities of their component amino acids, others require the aid of molecular chaperones to efficiently fold to their native states. Biochemists often refer to four distinct aspects of a protein's structure:

- *Primary structure*: the amino acid sequence
- *Secondary structure*: regularly repeating local structures stabilized by hydrogen bonds. The most common examples are the alpha helix and beta sheet. Because secondary structures are local, many regions of different secondary structure can be present in the same protein molecule.
- *Tertiary structure*: the overall shape of a single protein molecule; the spatial relationship of the secondary structures to one another. Tertiary structure is generally stabilized by nonlocal interactions, most commonly the formation of a hydrophobic core, but also through salt bridges, hydrogen bonds, disulfide bonds, and even post-translational modifications. The term "tertiary structure" is often used as synonymous with the term *fold*.
- *Quaternary structure*: the shape or structure that results from the interaction of more than one protein molecule, usually called *protein subunits* in this context, which function as part of the larger assembly or protein complex.

In addition to these levels of structure, proteins may shift between several related structures in performing their biological function. In the context of these functional

rearrangements, these tertiary or quaternary structures are usually referred to as "conformations," and transitions between them are called *conformational changes.* Such changes are often induced by the binding of a substrate molecule to an enzyme's active site, or the physical region of the protein that participates in chemical catalysis.



Molecular surface of several proteins showing their comparative sizes. From left to right are: Antibody (IgG), Hemoglobin, Insulin (a hormone), Adenylate kinase (an enzyme), and Glutamine synthetase (an enzyme).

Proteins can be informally divided into three main classes, which correlate with typical tertiary structures: globular proteins, fibrous proteins, and membrane proteins. Almost all globular proteins are soluble and many are enzymes. Fibrous proteins are often structural; membrane proteins often serve as receptors or provide channels for polar or charged molecules to pass through the cell membrane.

A special case of intramolecular hydrogen bonds within proteins, poorly shielded from water attack and hence promoting their own dehydration, are called dehydrons.

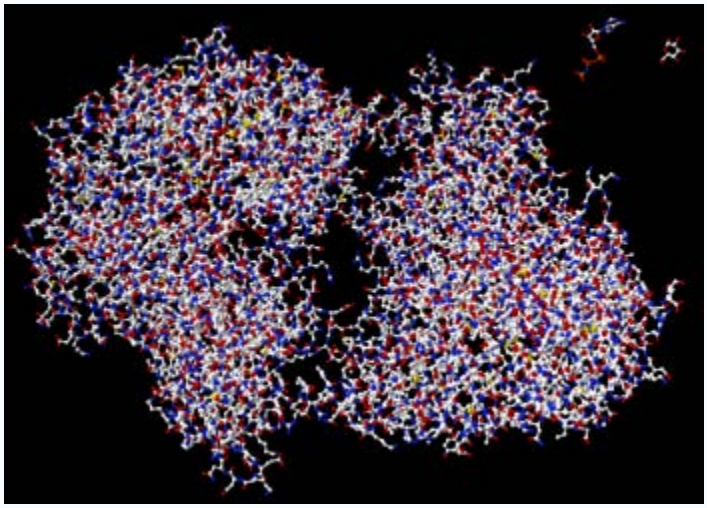
## Structure determination

Discovering the tertiary structure of a protein, or the quaternary structure of its complexes, can provide important clues about how the protein performs its function. Common experimental methods of structure determination include X-ray crystallography and NMR spectroscopy, both of which can produce information at atomic resolution. Cryoelectron microscopy is used to produce lower-resolution structural information about very large protein complexes, including assembled viruses; a variant known as electron crystallography can also produce high-resolution information in some cases, especially for two-dimensional crystals of membrane proteins. Solved structures are usually deposited in the Protein Data Bank (PDB), a freely available resource from which structural data about thousands of proteins can be obtained in the form of Cartesian coordinates for each atom in the protein.

There are many more known gene sequences than there are solved protein structures. Further, the set of solved structures is biased toward those proteins that can be easily subjected to the experimental conditions required by one of the major structure determination methods. In particular, globular proteins are comparatively easy to crystallize in preparation for X-ray crystallography, which remains the oldest and most common structure determination technique. Membrane proteins, by contrast, are difficult to crystallize and are underrepresented in the PDB. Structural genomics initiatives have attempted to remedy these deficiencies by systematically solving representative structures of major fold classes. Protein structure prediction methods attempt to provide a means of generating a plausible structure for a proteins whose structures have not been experimentally determined.

# Cellular functions

Proteins are the chief actors within the cell, said to be carrying out the duties specified by the information encoded in genes. With the exception of certain types of RNA, most other biological molecules are relatively inert elements upon which proteins act. Proteins make up half the dry weight of an E. coli cell, while other macromolecules such as DNA and RNA make up only 3% and 20% respectively. The total complement of proteins expressed in a particular cell or cell type is known as its proteome.



The enzyme hexokinase is shown as a simple ball-and-stick molecular model. To scale in the top right-hand corner are its two substrates, ATP and glucose.

The chief characteristic of proteins that enables them to carry out their diverse cellular functions is their ability to bind other molecules specifically and tightly. The region of

the protein responsible for binding another molecule is known as the binding site and is often a depression or "pocket" on the molecular surface. This binding ability is mediated by the tertiary structure of the protein, which defines the binding site pocket, and by the chemical properties of the surrounding amino acids' side chains. Protein binding can be extraordinarily tight and specific; for example, the ribonuclease inhibitor protein binds to human angiogenin with a sub-femtomolar dissociation constant ($<10^{-15}$ M) but does not bind at all to its amphibian homolog onconase (>1 M). Extremely minor chemical changes such as the addition of a single methyl group to a binding partner can sometimes suffice to nearly eliminate binding; for example, the aminoacyl tRNA synthetase specific to the amino acid valine discriminates against the very similar side chain of the amino acid isoleucine.

Proteins can bind to other proteins as well as to small-molecule substrates. When proteins bind specifically to other copies of the same molecule, they can oligomerize to form fibrils; this process occurs often in structural proteins that consist of globular monomers that self-associate to form rigid fibers. Protein-protein interactions also regulate enzymatic activity, control progression through the cell cycle, and allow the assembly of large protein complexes that carry out many closely related reactions with a common biological function. Proteins can also bind to, or even be integrated into, cell membranes. The ability of binding partners to induce conformational changes in proteins allows the construction of enormously complex signaling networks.

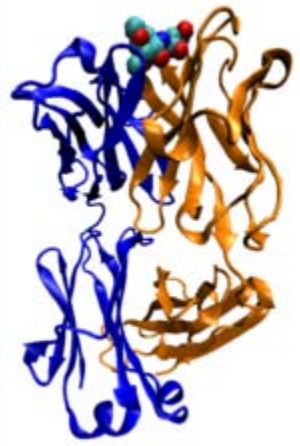
## Enzymes

The best-known role of proteins in the cell is their duty as enzymes, which catalyze chemical reactions. Enzymes are usually highly specific catalysts that accelerate only one or a few chemical reactions. Enzymes effect most of the reactions involved in metabolism and catabolism as well as DNA replication, DNA repair, and RNA synthesis. Some enzymes act on other proteins to add or remove chemical groups in a process known as post-translational modification. About 4,000 reactions are known to be catalyzed by enzymes. The rate acceleration conferred by enzymatic catalysis is often enormous - as much as $10^{17}$-fold increase in rate over the uncatalyzed reaction in the case of orotate decarboxylase.

The molecules bound and acted upon by enzymes are known as substrates. Although enzymes can consist of hundreds of amino acids, it is usually only a small fraction of the residues that come in contact with the substrate. and an even smaller fraction - 3-4

residues on average - that are directly involved in catalysis. The region of the enzyme that binds the substrate and contains the catalytic residues is known as the active site.

## Cell signaling and ligand transport



A mouse antibody against cholera that binds a carbohydrate antigen.

Many proteins are involved in the process of cell signaling and signal transduction. Some proteins, such as insulin, are extracellular proteins that transmit a signal from the cell in which they were synthesized to other cells in distant tissues. Others are membrane proteins that act as receptors whose main function is to bind a signaling molecule and induce a biochemical response in the cell. Many receptors are membrane proteins that have a binding site exposed on the cell surface and an effector domain within the cell, which may have enzymatic activity or may undergo a conformational change detected by other proteins within the cell.

Antibodies are protein components of adaptive immune system whose main function is to bind antigens, or foreign substances in the body, and target them for destruction. Antibodies can be secreted into the extracellular environment or anchored in the membranes of specialized B cells known as plasma cells. While enzymes are limited in their binding affinity for their substrates by the necessity of conducting their reaction, antibodies have no such constraints. An antibody's binding affinity to its target is extraordinarily high.

Many ligand transport proteins bind particular small biomolecules and transport them to other locations in the body of a multicellular organism. These proteins must have a high binding affinity when their ligand is present in high concentrations but must also release the ligand when it is present at low concentrations in the target tissues. The canonical

example of a ligand-binding protein is haemoglobin, which transports oxygen from the lungs to other organs and tissues in all vertebrates and has close homologs in every biological kingdom.

Transmembrane proteins can also serve as ligand transport proteins that alter the permeability of the cell's membrane to small molecules and ions. The membrane alone has a hydrophobic core through which polar or charged molecules cannot diffuse. Membrane proteins contain internal channels that allow such molecules to enter and exit the cell. Many ion channel proteins are specialized to select for only a particular ion; for example, potassium and sodium channels often discriminate for only one of the two ions.

### Structural proteins

Structural proteins confer stiffness and rigidity to otherwise fluid biological components. Most structural proteins are fibrous proteins; for example, actin and tubulin are globular and soluble as monomers but polymerize to form long, stiff fibers that comprise the cytoskeleton, which allows the cell to maintain its shape and size. Collagen and elastin are critical components of connective tissue such as cartilage, and keratin is found in hard or filamentous structures such as hair, nails, feathers, hooves, and some animal shells.

Other proteins that serve structural functions are motor proteins such as myosin, kinesin, and dynein, which are capable of generating mechanical forces. These proteins are crucial for cellular motility of single-celled organisms and the sperm of many sexually reproducing multicellular organisms. They also generate the forces exerted by contracting muscles.

## Methods of study

*Protein methods*

As some of the most commonly studied biological molecules, the activities and structures of proteins are examined both *in vitro* and *in vivo*. *In vitro* studies of purified proteins in controlled environments are useful for learning how a protein carries out its function: for example, enzyme kinetics studies explore the chemical mechanism of an enzyme's catalytic activity and its relative affinity for various possible substrate molecules. By

contrast, *in vivo* experiments on proteins' activities within cells or even within whole organisms can provide complementary information about where a protein functions and how it is regulated.

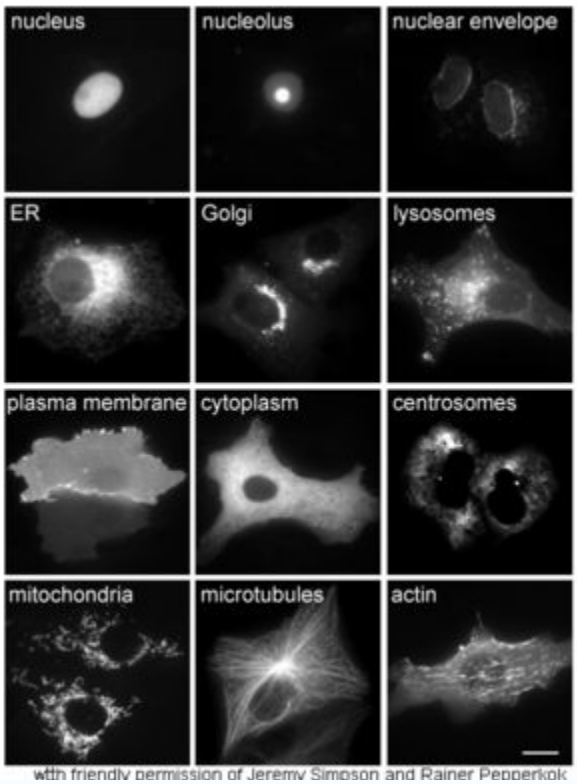
## Protein purification

*Protein purification*

In order to perform *in vitro* analyses, a protein must be purified away from other cellular components. This process usually begins with cell lysis, in which a cell's membrane is disrupted and its internal contents released into a solution known as a crude lysate. The resulting mixture can be purified using ultracentrifugation, which fractionates the various cellular components into fractions containing soluble proteins; membrane lipids and proteins; cellular organelles, and nucleic acids. Precipitation by a method known as salting out can concentrate the proteins from this lysate. Various types of chromatography are then used to isolate the protein or proteins of interest based on properties such as molecular weight, net charge and binding affinity. The level of purification can be monitored using gel electrophoresis if the desired protein's molecular weight is known, by spectroscopy if the protein has distinguishable spectroscopic features, or by enzyme assays if the protein has enzymatic activity.

For natural proteins, a series of purification steps may be necessary to obtain protein sufficiently pure for laboratory applications. To simplify this process, genetic engineering is often used to add chemical features to proteins that make them easier to purify without affecting their structure or activity. Here, a "tag" consisting of a specific amino acid sequence, often a series of histidine residues (a "His-tag"), is attached to one terminus of the protein. As a result, when the lysate is passed over a chromatography column containing nickel, the histidine residues ligate the nickel and attach to the column while the untagged components of the lysate pass unimpeded.

## Cellular localization



Proteins in different cellular compartments and structures tagged with green fluorescent protein.

The study of proteins *in vivo* is often concerned with the synthesis and localization of the protein within the cell. Although many intracellular proteins are synthesized in the cytoplasm and membrane-bound or secreted proteins in the endoplasmic reticulum, the specifics of how proteins are targeted to specific organelles or cellular structures is often unclear. A useful technique for assessing cellular localization uses genetic engineering to express in a cell a fusion protein or chimera consisting of the natural protein of interest linked to a "reporter" such as green fluorescent protein (GFP). The fused protein's position within the cell can be cleanly and efficiently visualized using microscopy, as shown in the figure opposite.

Through another genetic engineering application known as site-directed mutagenesis, researchers can alter the protein sequence and hence its structure, cellular localization, and susceptibility to regulation, which can be followed *in vivo* by GFP tagging or *in vitro* by enzyme kinetics and binding studies.

## Proteomics and bioinformatics

The total complement of proteins present in a cell or cell type is known as its proteome, and the study of such large-scale data sets defines the field of proteomics, named by analogy to the related field of genomics. Key experimental techniques in proteomics include protein microarrays, which allow the detection of the relative levels of a large number of proteins present in a cell, and two-hybrid screening, which allows the systematic exploration of protein-protein interactions. The total complement of biologically possible such interactions is known as the interactome. A systematic attempt to determine the structures of proteins representing every possible fold is known as structural genomics.

The large amount of genomic and proteomic data available for a variety of organisms, including the human genome, allows researchers to efficiently identify homologous proteins in distantly related organisms by sequence alignment. Sequence profiling tools can perform more specific sequence manipulations such as restriction enzyme maps, open reading frame analyses for nucleotide sequences, and secondary structure prediction. From this data phylogenetic trees can be constructed and evolutionary hypotheses developed using special software like ClustalW regarding the ancestry of modern organisms and the genes they express. The field of bioinformatics seeks to assemble, annotate, and analyze genomic and proteomic data, applying computational techniques to biological problems such as gene finding and cladistics.

## Structure prediction and simulation

Complementary to the field of structural genomics, protein structure prediction seeks to develop efficient ways to provide plausible models for proteins whose structures have not yet been determined experimentally. The most successful type of structure prediction, known as homology modeling, relies on the existence of a "template" structure with sequence similarity to the protein being modeled; structural genomics' goal is to provide sufficient representation in solved structures to model most of those that remain. Although producing accurate models remains a challenge when only distantly related template structures are available, it has been suggested that sequence alignment is the bottleneck in this process, as quite accurate models can be produced if a "perfect" sequence alignment is known. Many structure prediction methods have served to inform the emerging field of protein engineering, in which novel protein folds have already been designed. A more complex computational problem is the prediction of intermolecular interactions, such as in molecular docking and protein-protein interaction prediction.

The processes of protein folding and binding can be simulated using techniques derived from molecular dynamics, which increasingly take advantage of distributed computing as in the Folding@Home project. The folding of small alpha-helical protein domains such as the villin headpiece and the HIV accessory protein have been successfully simulated *in silico*, and hybrid methods that combine standard molecular dynamics with quantum mechanics calculations have allowed exploration of the electronic states of rhodopsins.

# Nutrition

sMost microorganisms and plants can biosynthesize all 20 standard amino acids, while animals must obtain some of the amino acids from the diet. Key enzymes in the biosynthetic pathways that synthesize certain amino acids - such as aspartokinase, which catalyzes the first step in the synthesis of lysine, methionine, and threonine from aspartate - are not present in animals. The amino acids that an organism cannot synthesize on its own are referred to as essential amino acids. (This designation is often used to specifically identify those essential to humans.) If amino acids are present in the environment, most microorganisms can conserve energy by taking up the amino acids from the environment and downregulating their own biosynthetic pathways. Bacteria are often engineered in the laboratory to lack the genes necessary for synthesizing a particular amino acid, providing a selectable marker for the success of transfection, or the introduction of foreign DNA.

In animals, amino acids are obtained through the consumption of foods containing protein. Ingested proteins are broken down through digestion, which typically involves denaturation of the protein through exposure to acid and degradation by the action of enzymes called proteases. Ingestion of essential amino acids is critical to the health of the organism, since the biosynthesis of proteins that include these amino acids is inhibited by their low concentration. Amino acids are also an important dietary source of nitrogen. Some ingested amino acids, especially those that are not essential, are not used directly for protein biosynthesis. Instead, they are converted to carbohydrates through gluconeogenesis, which is also used under starvation conditions to generate glucose from the body's own proteins, particularly those found in muscle.

# History

Proteins were recognized as a distinct class of biological molecules in the eighteenth century by Antoine Fourcroy and others. Members of this class (called the "albuminoids", *Eiweisskörper*, or *matières albuminoides*) were recognized by their ability to coagulate or flocculate under various treatments such as heat or acid; well-known examples at the start of the nineteenth century included albumen from egg whites, blood serum albumin, fibrin, and wheat gluten. The similarity between the cooking of egg whites and the curdling of milk was recognized even in ancient times; for example, the name *albumen* for the egg-white protein was coined by Pliny the Elder from the Latin *albus ovi* (egg white).

With the advice of Jöns Jakob Berzelius, the Dutch chemist Gerhardus Johannes Mulder carried out elemental analyses of common animal and plant proteins. To everyone's surprise, all proteins had nearly the same empirical formula, roughly $C_{400}H_{620}N_{100}O_{120}$ with individual sulfur and phosphorus atoms. Mulder published his findings in two papers (1837,1838) and hypothesized that there was one basic substance (*Grundstoff*) of proteins, and that it was synthesized by plants and absorbed from them by animals in digestion. Berzelius was an early proponent of this theory and proposed the name "protein" for this substance in a letter dated 10 July 1838

> The name protein that I propose for the organic oxide of fibrin and albumin, I wanted to derive from [the Greek word] πρωτειος, because it appears to be the primitive or principal substance of animal nutrition.

Mulder went on to identify the products of protein degradation such as the amino acid, leucine, for which he found a (nearly correct) molecular weight of 131 Da.

The minimum molecular weight suggested by Mulder's analyses was roughly 9 kDa, hundreds of times larger than other molecules being studied. Hence, the chemical structure of proteins (their primary structure) was an active area of research until 1949, when Fred Sanger sequenced insulin. The (correct) theory that proteins were linear polymers of amino acids linked by peptide bonds was proposed independently and simultaneously by Franz Hofmeister and Emil Fischer at the same conference in 1902. However, some scientists were sceptical that such long macromolecules could be stable in solution. Consequently, numerous alternative theories of the protein primary structure were proposed, e.g., the colloidal hypothesis that proteins were assemblies of small molecules, the cyclol hypothesis of Dorothy Wrinch, the diketopiperazine hypothesis of

Emil Abderhalden and the pyrrol/piperidine hypothesis of Troensgard (1942). Most of these theories had dificulties in accounting for the fact that the digestion of proteins yielded peptides and amino acids. Proteins were finally shown to be macromolecules of well-defined composition (and not colloidal mixtures) by Theodor Svedberg using analytical ultracentrifugation. The possibility that some proteins are non-covalent associations of such macromolecules was shown by Gilbert Smithson Adair (by measuring the osmotic pressure of hemoglobin) and, later, by Frederic M. Richards in his studies of ribonuclease S. The mass spectrometry of proteins has long been a useful technique for identifying posttranslational modifications and, more recently, for probing protein structure.

Most proteins are difficult to purify in more than milligram quantities, even using the most modern methods. Hence, early studies focused on proteins that could be purified in large quantities, e.g., those of blood, egg white, various toxins, and digestive/metabolic enzymes obtained from slaughterhouses. Many techniques of protein purification were developed during World War II in a project led by Edwin Joseph Cohn to purify blood proteins to help keep soldiers alive. In the late 1950's, the Armour Hot Dog Co. purified 1 kg (= one million milligrams) of pure bovine pancreatic ribonuclease A and made it freely available to scientists around the world. This generous act made RNase A the main protein for basic research for the next few decades, resulting in several Nobel Prizes.

The study of protein folding began in 1910 with a famous paper by Henrietta Chick and C. J. Martin, in which they showed that the flocculation of a protein was composed of two distinct processes: the precipitation of a protein from solution was *preceded* by another process called denaturation, in which the protein became much less soluble, lost its enzymatic activity and became more chemically reactive. In the mid-1920's, Tim Anson and Alfred Mirsky proposed that denaturation was a reversible process, a correct hypothesis that was initially lampooned by some scientists as "unboiling the egg". Anson also suggested that denaturation was a two-state ("all-or-none") process, in which one fundamental molecular transition resulted in the drastic changes in solubility, enzymatic activity and chemical reactivity; he further noted the the free energy changes upon denaturation were much smaller than those typically involved in chemical reactions. In 1929, Hsien Wu hypothesized that denaturation was protein folding, a purely conformational change that resulted in the exposure of amino acid side chains to the solvent. According to this (correct) hypothesis, exposure of aliphatic and reactive side chains to solvent rendered the protein less soluble and more reactive, whereas the loss of

a specific conformation caused the loss of enzymatic activity. Although considered plausible, Wu's hypothesis was not immediately accepted, since so little was known of protein structure and enzymology and other factors could account for the changes in solubility, enzymatic activity and chemical reactivity. In the early 1960's, Chris Anfinsen showed that the folding of ribonuclease A was fully reversible with no external cofactors needed, verifying the "thermodynamic hypothesis" of protein folding that the folded state represents the global minimum of free energy for the protein.

The hypothesis of protein folding was followed by research into the physical interactions that stabilize folded protein structures. The crucial role of hydrophobic interactions was hypothesized by Dorothy Wrinch and Irving Langmuir, as a mechanism that might stabilize her cyclol structures. Although supported by J. D. Bernal and others, this (correct) hypothesis was rejected along with the cyclol hypothesis, which was disproven in the 1930's by Linus Pauling (among others). Instead, Pauling championed the idea that protein structure was stabilized mainly by hydrogen bonds, an idea advanced initially by William Astbury (1933). Remarkably, Pauling's incorrect theory about H-bonds resulted in his *correct* models for the secondary structure elements of proteins, the alpha helix and the beta sheet. The hydrophobic interaction was restored to its correct prominence by a famous article in 1959 by Walter Kauzman on denaturation, based partly on work by Kaj Linderstrom-Lang. The ionic nature of proteins was demonstrated by Bjerrum, Weber and Arne Tiselius, but Linderstrom-Lang showed that the charges were generally accessible to solvent and not bound to each other (1949).

The secondary and low-resolution tertiary structure of globular proteins was investigated initially by hydrodynamic methods, such as analytical ultracentrifugation and flow birefringence. Spectroscopic methods to probe protein structure (such as circular dichroism, fluorescence, near-ultraviolet and infrared absorbance) were developed in the 1950's. The first atomic-resolution structures of proteins were solved by X-ray crystallography in the 1960's and by NMR in the 1980's. As of 2006, the Protein Data Bank has nearly 40,000 atomic-resolution structures of proteins. In more recent times, cryo-electron microscopy of large macromolecular assemblies and computational protein structure prediction of small protein domains are two methods approaching atomic resolution.

# Obesity

| Obesity<br>*Classifications and external resources* | |
|---|---|
|  <br>An obese man. Painting "The Tuscan General" by Alessandro del Borro, 17th century. | |
| **ICD-10** | E66. |
| **ICD-9** | 278 |
| **DiseasesDB** | 9099 |
| **MedlinePlus** | 003101 |
| **eMedicine** | med/1653 |
| **MeSH** | *C23.888.144.699.500* |

**Obesity** is a condition in which the natural energy reserve, stored in the fatty tissue of humans and other mammals, is increased to a point where it is a risk factor for certain health conditions or increased mortality. Obesity develops from the interaction of individual biology and the environment. Excessive body weight has been shown to predispose to various diseases, particularly cardiovascular disease, diabetes mellitus type

2, sleep apnea, and osteoarthritis. Obesity is both an individual clinical condition and is increasingly viewed as a serious public health problem.

# Definition

In the clinical setting, obesity is typically evaluated by measuring BMI (body mass index), waist circumference, and evaluating the presence of risk factors and comorbidities. In epidemiological studies BMI alone is used to define obesity.

## BMI

BMI was developed by the Belgian statistician and anthropometrist Adolphe Quetelet. It is calculated by dividing the subject's weight in kilograms by the square of his/her height in metres ($BMI = kg / m^2$).

The current definitions commonly in use establish the following values, agreed in 1997 and published in 2000:

- A BMI less than 18.5 is *underweight*
- A BMI of 18.5 - 24.9 is *normal weight*
- A BMI of 25.0 - 29.9 is *overweight*
- A BMI of 30.0 - 39.9 is *obese*
- A BMI of 40.0 or higher is *severely (or morbidly) obese*

BMI is a simple and widely used method for estimating body fat. In epidemiology BMI alone is used as an indicator of prevalence and incidence.

BMI as an indicator of a clinical condition is used in conjunction with other clinical assessments, such as waist circumference. In a *clinical* setting, physicians take into account race, ethnicity, lean mass (muscularity), age, sex, and other factors which can affect the interpretation of BMI. BMI overestimates body fat in persons who are very muscular, and it can underestimate body fat in persons who have lost body mass (e.g. many elderly). Mild obesity as defined by BMI alone is not a cardiac risk factor, and hence BMI cannot be used as a sole clinical and epidemiological predictor of cardiovascular health.

## Waist circumference

BMI does not take into account differing ratios of adipose to lean tissue; nor does it distinguish between differing forms of adiposity, some of which may correlate more closely with cardiovascular risk. Increasing understanding of the biology of different forms of adipose tissue has shown that *visceral* fat or *central obesity* (male-type or apple-type obesity) has a much stronger correlation, particularly with cardiovascular disease, than the BMI alone.

The absolute waist circumference (>102 cm in men and >88 cm in women) or waist-hip ratio (>0.9 for men and >0.85 for women) are both used as measures of central obesity.

### Body fat measurement

An alternative way to determine obesity is to assess percent body fat. Doctors and scientists generally agree that men with more than 25% body fat and women with more than 30% body fat are obese. However, it is difficult to measure body fat precisely. The most accepted method has been to weigh a person underwater, but underwater weighing is a procedure limited to laboratories with special equipment. Two simpler methods for measuring body fat are the *skinfold test*, in which a pinch of skin is precisely measured to determine the thickness of the subcutaneous fat layer; or bioelectrical impedance analysis, usually only carried out at specialist clinics.

### Gestalt

In practice, for most examples of overweight that may designate risk, both doctor and patient can see "by eye" whether excess fat is a concern. In these cases, BMI thresholds provide simple targets all patients can understand.

### Risk factors and comorbidities

The presence of risk factors and diseases associated with obesity are also used to establish a clinical diagnosis. Coronary heart disease, type 2 diabetes, and sleep apnea are possible life-threatening risk factors that would indicate clinical treatment of obesity. Smoking, hypertension, age and family history are other risk factors that may indicate treatment. Diabetes and heart disease are risk factors used in epidemiological studies of obesity.

## Causes

## Causative factors

When food energy intake exceeds energy expenditure, fat cells (and to a lesser extent muscle and liver cells) throughout the body take in the energy and store it as fat. In its simplest conception, therefore, obesity is only made possible when the lifetime energy intake exceeds lifetime energy expenditure by more than it does for individuals of "normal weight".

In all individuals, the excess energy utilized to generate fat reserves is minute relative to the total number of calories consumed. This means that very fine perturbations in the energy balance can lead to large fluctuations in weight over time. To illustrate, an obese 40 year old who carries 100 lb of adipose tissue has only consumed about 25 more calories per day than he has burned on average - or the equivalent of an apple every three days. In comparison a very lean 40-year-old who carries only 15 lb of body fat will have exceeded his daily energy expenditure by about four calories a day - the equivalent of an apple every 18 days.

Factors that have been suggested to contribute to the development of obesity include:

- Genetic factors and some genetic disorders (e.g., Prader-Willi syndrome)
- Underlying illness (e.g. hypothyroidism)
- Certain medications (e.g., atypical antipsychotics)
- Sedentary lifestyle
- A high glycemic diet (i.e., a diet that consists of meals that give high postprandial blood sugar)
- Weight cycling, caused by repeated attempts to lose weight by dieting
- Eating disorders (such as binge eating disorder)
- Stressful mentality
- Insufficient sleep
- Smoking cessation

As with many medical conditions, the caloric imbalance that results in obesity often develops from a combination of genetic and environmental factors. Polymorphisms in various genes controlling appetite, metabolism, and adipokine release predispose to obesity, but the condition requires availability of sufficient calories, and possibly other factors, to develop fully. Various genetic abnormalities that predispose to obesity have been identified (such as Prader-Willi syndrome and leptin receptor mutations), but known single-locus mutations have been found in only about 5% of obese individuals. While it is thought that a large proportion of the causative genes are still to be identified, much

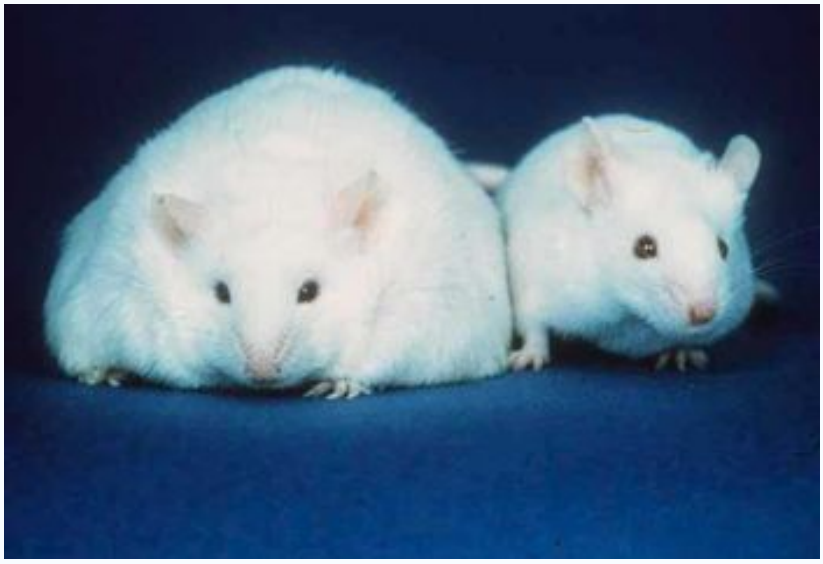
obesity is likely the result of interactions between multiple genes, and non-genetic factors are likely also important.

Some eating disorders are associated with obesity, especially binge eating disorder (BED). As the name indicates, patients with this disorder are prone to overeat, often in binges. A proposed mechanism is that the eating serves to reduce anxiety, and some parallels with substance abuse can be drawn. An important additional factor is that BED patients often lack the ability to recognize hunger and satiety, something that is normally learned in childhood. Learning theory suggests that early childhood conceptions may lead to an association between food and a calm mental state.

## Evolutionary aspects

Although there is no definitive explanation for the recent increase of obesity, the thrifty gene hypothesis provides some understanding of this phenomenon, and suggests why certain populations and individuals may be more prone to obesity than others. In times when food was scarce, the ability to take advantage of rare periods of abundance and use such abundance by storing energy efficiently was undoubtedly an evolutionary advantage. Individuals with greater adipose reserves were more likely to survive famine. This tendency to store fat is likely maladaptive in a society with adequate and stable food supplies.

## Neurobiological mechanisms



Scientists investigating the mechanisms and treatment of obesity may use animal models such as mice to conduct experiments.

Flier summarizes the many possible pathophysiological mechanisms involved in the development and maintenance of obesity. This field of research had been almost unapproached until leptin was discovered in 1994. Since this discovery, many other hormonal mechanisms have been elucidated that participate in the regulation of appetite and food intake, storage patterns of adipose tissue, development of insulin resistance. Since leptin's discovery, ghrelin, orexin, PYY 3-36, cholecystokinin, adiponectin, and many other mediators have been studied. The adipokines are mediators produced by adipose tissue; their action is thought to modify many obesity-related diseases.

Leptin and ghrelin are considered to be complementary in their influence on appetite, with ghrelin produced by the stomach modulating short-term appetitive control (i.e. to eat when the stomach is empty and to stop when the stomach is stretched). Leptin is produced by adipose tissue to signal fat storage reserves in the body, and mediates long-term appetitive controls (i.e. to eat more when fat storages are low and less when fat storages are high). Although administration of leptin may be effective in a small subset of obese individuals who are leptin-deficient, many more obese individuals are thought to be leptin-resistant, and this resistance has been implicated in obesity in some people, is thought to explain in part why administration of leptin has not been shown to be effective in suppressing appetite in most obese subjects.

Neuroscientific approaches hinge on the action of the aforementioned mediators on the hypothalamus, the part of the brain that is thought to process signals related to metabolic state and energy storage and to shift the energy balance in either a positive or negative direction, primarily by acting on appetite and energy expenditure. Lesion studies in the 1940s and 1950s identified two regions of the hypothalamus — the lateral hypothalamus (LH) and ventromedial hypothalamus (VMH) — as the brain's hunger and satiety centers, respectively. Specific lesions to a mouse's LH suppressed its appetite while damaging the VMH caused overeating.

Studies of the distribution of the leptin receptor in the mid-1990s cast doubt upon this dual center theory of hunger and satiety. Leptin's effect on the arcuate nucleus melanocortin system is now considered central to the regulation of feeding and metabolism.

### Poverty link

Some obesity co-factors are resistant to the theory that the "epidemic" is a new phenomenon. In particular, a class co-factor consistently appears across many studies. Comparing net worth with BMI scores, a 2004 study found obese American subjects approximately half as wealthy as thin ones. When income differentials were factored out, the inequity persisted — thin subjects were inheriting more wealth than fat ones. A higher rate of lack of education and tendencies to rely on cheaper fast foods is seen as a reason why these results are so dissimilar. Another study finds women who married into higher status are predictably thinner than women who married into lower status.

## Complications

Obesity, especially central obesity (male-type or waist-predominant obesity), is an important risk factor for the "metabolic syndrome" ("syndrome X"), the clustering of a number of diseases and risk factors that heavily predispose for cardiovascular disease. These are diabetes mellitus type 2, high blood pressure, high blood cholesterol, and triglyceride levels (combined hyperlipidemia). An inflammatory state is present, which — together with the above — has been implicated in the high prevalence of atherosclerosis (fatty lumps in the arterial wall), and a prothrombotic state may further worsen cardiovascular risk.

Apart from the metabolic syndrome, obesity is also correlated (in population studies) with a variety of other complications. For many of these complaints, it has not been clearly established to what extent they are caused directly by obesity itself, or have some other cause (such as limited exercise) that causes obesity as well. Most confidence in a direct cause is given to the mechanical complications in the following list:

- *Cardiovascular*: congestive heart failure, enlarged heart and its associated arrhythmias and dizziness, cor pulmonale, varicose veins, and pulmonary embolism
- *Endocrine*: polycystic ovarian syndrome (PCOS), menstrual disorders, and infertility
- *Gastrointestinal*: gastroesophageal reflux disease (GERD), fatty liver disease, cholelithiasis (gallstones), hernia, and colorectal cancer
- *Renal and genitourinary*: urinary incontinence, glomerulopathy, hypogonadism (male), breast cancer (female), uterine cancer (female), stillbirth
- *Integument* (skin and appendages): stretch marks, acanthosis nigricans, lymphedema, cellulitis, carbuncles, intertrigo

- *Musculoskeletal*: hyperuricemia (which predisposes to gout), immobility, osteoarthritis, low back pain
- *Neurologic*: stroke, meralgia paresthetica, headache, carpal tunnel syndrome, dementia10. ^
- *Respiratory*: dyspnea, obstructive sleep apnea, hypoventilation syndrome, Pickwickian syndrome, asthma
- *Psychological*: Depression, low self esteem, body dysmorphic disorder, social stigmatization

While being severely obese has many health ramifications, those who are somewhat overweight face little increased mortality or morbidity. Some studies suggest that the somewhat "overweight" tend to live longer than those at their "ideal" weight. This may in part be attributable to lower mortality rates in diseases where death is either caused or contributed to by significant weight loss due to the greater risk of being underweight experienced by those in the ideal category. Another factor which may confound mortality data is smoking, since obese individuals are less likely to smoke. Osteoporosis is known to occur less in slightly overweight people.

# Therapy

The mainstay of treatment for obesity is an energy-limited diet and increased exercise. In studies, diet and exercise programs have consistently produced an average weight loss of approximately 8% of total body mass on average (excluding study drop-outs). While not all dieters will be satisfied with this outcome, studies have shown that a loss of as little as 5% of body mass can create enormous health benefits.

A more intractable therapeutic problem appears to be weight loss maintenance. Of dieters who manage to lose 10% or more of their body mass in studies, 80-95% will regain that weight within two to five years. It appears that the homeostatic mechanisms regulating body weight are very robust (see leptin, for example), and vigorously defend against weight loss. Much important research is now being devoted to determining what factors can improve the currently dismal weight loss maintenance rates.

Recent scientific research has cast some doubt over whether or not dieting actually improves health, with some studies indicating that dieting may in fact be more detrimental than remaining overweight.

In a clinical practice guideline by the American College of Physicians, the following five recommendations are made:

1. People with a BMI of over 30 should be counseled on diet, exercise and other relevant behavioral interventions, and set a realistic goal for weight loss.
2. If these goals are not achieved, pharmacotherapy can be offered. The patient needs to be informed of the possibility of side-effects and the unavailability of long-term safety and efficacy data.
3. Drug therapy may consist of sibutramine, orlistat, phentermine, diethylpropion, fluoxetine, and bupropion. For more severe cases of obesity, stronger drugs such as amphetamine and methamphetamine may be used on a selective basis. Evidence is not sufficient to recommend sertraline, topiramate, or zonisamide.
4. In patients with BMI > 40 who fail to achieve their weight loss goals (with or without medication) and who develop obesity-related complications, referral for bariatric surgery may be indicated. The patient needs to be aware of the potential complications.
5. Those requiring bariatric surgery should be referred to high-volume referral centers, as the evidence suggests that surgeons who frequently perform these procedures have fewer complications.

Much research focuses on new drugs to combat obesity, which is seen as the biggest health problem facing developed countries. Nutritionists and many doctors feel that these research funds would be better devoted to advice on good nutrition, healthy eating, and promoting a more active lifestyle.

Medication most commonly prescribed for diet/exercise-resistant obesity is orlistat (Xenical, which reduces intestinal fat absorption by inhibiting pancreatic lipase) and sibutramine (Reductil, Meridia, an anorectic). In the presence of diabetes mellitus, there is evidence that the anti-diabetic drug metformin (Glucophage) can assist in weight loss — rather than sulfonylurea derivatives and insulin, which often lead to further weight gain. The thiazolidinediones (rosiglitazone or pioglitazone) can cause slight weight gain, but decrease the "pathologic" form of abdominal fat, and are therefore often used in obese diabetics.

Increasingly, *bariatric surgery* is being used to combat obesity. The most common weight loss surgery in Europe and Australia is the adjustable gastric band where a silicone ring is placed around the top of the stomach to help restrict the amount of food eaten in a sitting. This surgery has been FDA approved in the United States since 2001 but has been being used in other parts of the world since the early 1990s. It is considered the safest and least invasive of the available weight loss surgeries such as Roux-en-Y gastric bypass surgery (RNY), biliopancreatic diversion, and stomach stapling (also known as "vertical banded gastroplasty", VBG). Unlike those more invasive techniques the band surgery does not cut into or reroute any of the digestive tract and is completely

reversible. Removing the implant returns the stomach to its pre-surgical norm. All of these surgeries can be done laparoscopically. The more invasive of the surgeries usually bypass or remove some portion of the patient's intestines which causes malabsorption and dumping.

All of these surgeries come with risk to the patient. For instance a recent study by the U.S. Department of Health and Human Service showed a 40% complication rate within 180 days of bariatric surgery. Moreover these surgeries do not guarantee either successful weight loss or reduced morbidity and mortality. Patients are also required to make lifelong changes to their diet if they are to keep the lost weight off in the long term. Therefore, as with any major surgery, patients needs to carefully evalute the long term ramifications of their choice.

# Cultural and social significance

## Etymology

*Obesity* is the nominal form of *obese* which comes from the Latin *obēsus*, which means "stout, fat, or plump." *Ēsus* is the past participle of *edere* (to eat), with *ob* added to it. In Classical Latin, this verb is seen only in past participial form. Its first attested usage in English was in 1651, in Noah Biggs's *Matæotechnia Medicinæ Praxeos*.

## History and obesity

Venus of Willendorf

In several human cultures, obesity was associated with physical attractiveness, strength, and fertility. Some of the earliest known cultural artifacts, known as Venus figurines, are pocket-sized statuettes representing an obese female figure. Although their cultural significance is unrecorded, their widespread use throughout pre-historic Mediterranean and European cultures suggests a central role for the obese female form in magical

rituals, and suggests cultural approval of (and perhaps reverence for) this body form. This is most likely due to their ability to easily bear children and survive famine.

Obesity was occasionally considered a symbol of wealth and social status in cultures prone to food shortages or famine. Well into the early modern period in European cultures, it often served this role. But as food security was realised, it came to serve more as a visible signifier of "lust for life", appetite, and immersion in the realm of the erotic. This was especially the case in the visual arts, such as the paintings of Rubens (1577–1640), whose regular use of the full female figures gives us the description *Rubenesque* for plumpness. Obesity can also be seen as a symbol within a system of prestige. "The kind of food, the quantity, and the manner in which it is served are among the important criteria of social class. In most tribal societies, even those with a highly stratified social system, everyone - royalty and the commoners - ate the same kind of food, and if there was famine everyone was hungry. With the ever increasing diversity of foods, food has become not only a matter of social status, but also a mark of one's personality and taste."

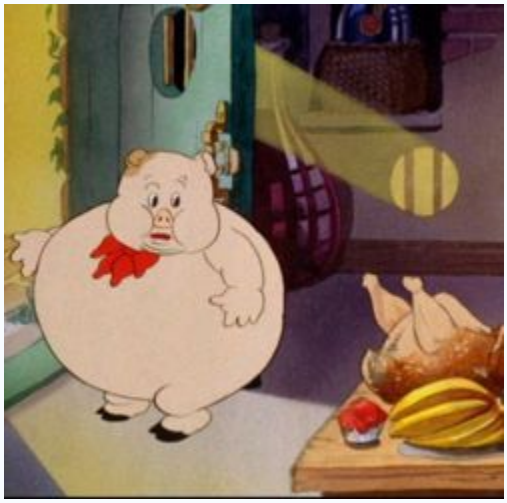
## Contemporary culture

In modern Western culture, the obese body shape is widely regarded as unattractive. Obese bodies are rarely positively represented in mainstream media. Many negative stereotypes are commonly associated with obese people, such as the belief that they are lazy, dirty, stupid, or even evil. Some point to gluttony, the second of the seven deadly sins, when referring to the this last stereotype. Obese children, teenagers and adults face a heavy social stigma. Obese children are frequently the targets of bullies and are often shunned by their peers. Obesity in adulthood can lead to a slower rate of career advancement. Most obese people have experienced negative thoughts about their body image, and many take drastic steps to try to change their shape.

Not all contemporary cultures disapprove of obesity. There are many cultures which are traditionally more approving (to varying degrees) of obesity, including some African, Arabic, Indian, and Pacific Island cultures. Especially in recent decades, obesity has come to be seen more as a medical condition in modern Western culture.

Recently emerging is a small but vocal fat acceptance movement that seeks to challenge weight-based discrimination. Obesity acceptance and advocacy groups have initiated litigation to defend the rights of obese people and to prevent their social exclusion.

### Popular culture



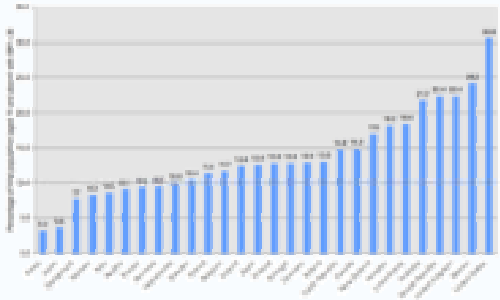
In cartoons, obesity is often used for comic effect.

Various stereotypes of obese people have found their way into expressions of popular culture. A common stereotype is the obese character who has a warm and dependable personality, but equally common is the obese vicious bully. Gluttony and obesity are commonly depicted together in works of fiction. In cartoons, obesity is often used to comedic effect, with fat cartoon characters having to squeeze through narrow spaces, frequently getting stuck or even exploding.

It can be argued that depiction in popular culture adds to and maintains commonly perceived stereotypes, in turn harming self esteem of obese people. A charge of discrimination on the basis of appearance could be leveled against these depictions.

On the other hand, obesity is often associated with positive characteristics such as good humor (the stereotype of the jolly fat man like Santa Claus), and some people are more sexually attracted to obese people than to slender people (see chubby culture, fat admirer).

## Public health and policy



Graphic chart comparing obesity percentages of the total population in OECD member countries.

## Prevalence

Iran

Variations in wealth result in malnutrition and obesity co-existing. According to a 1997 survey, the prevalences of moderate and severe underweight, stunting, and wasting in under-five year children were 10.9%, 15.9%, and 4.9%, respectively, while the prevalence of overweight was 4.3%. Obesity in girls in Tehran and other large cities was recorded at more than 13%.

United Kingdom

The Health Survey for England predicts that more than 12 million adults and 1 million children will be obese by 2010 if no action is taken. The prime minister has urged people to take more responsibility for their fitness and diet.

United States

The prevalence of overweight and obesity in the United States makes obesity a leading public health problem. The United States has the highest rates of obesity in the developed world. From 1980 to 2002, obesity has doubled in adults and overweight prevalence has tripled in children and adolescents. From 2003-2004, "children and adolescents aged 2 to 19 years, 17.1% were overweight...and 32.2% of adults aged 20 years or older were obese." The prevalence in the United States continues to rise. The prevalence of obesity has been continually rising for two decades. This sudden rise in obesity prevalence is attributed to environmental and population factors rather than individual behavior and biology because of the rapid and continual rise in the number of overweight and obese individuals. The current environment produces risk factors for decreased physical activity

and for increased calorie consumption. These environmental factors operate on the population to decrease physical activity and increase calorie consumption.

Venezuela

More than 21% of the population of Venezuela is obese.

## Environmental factors

While it may often appear obvious why a certain individual gets fat, it is far more difficult to understand why the average weight of certain societies have recently been growing. While genetic causes are central to understanding obesity, they cannot fully explain why one culture grows fatter than another.

This is most notable in the United States. In the years from just after the Second World War until 1960 the average person's weight increased, but few were obese. In the two and a half decades since 1980 the growth in the rate of obesity has accelerated markedly and is increasingly becoming a public health concern.

There are a number of theories as to the cause of this change since 1980. Most believe it is a combination of various factors.

- *Lack of activity*: obese people appear to be less active in general than lean people, and not just because of their obesity. A controlled increase in calorie intake of lean people did not make them less active; correspondingly when obese people lost weight they did not become more active. Weight change does not affect activity levels, but the converse seems to be the case.

- One of the most important is the much *lower relative cost of foodstuffs*: massive changes in agricultural policy in the United States and Europe have led to food prices for consumers being lower than at any point in history. Sugar and corn syrup, two huge sources of food energy, are some of the most subsidized products by the United States government. This can raise costs for consumers in some areas but greatly lower it in others. Current debates into trade policy highlight disagreements on the effects of subsidies.

- *Increased marketing* has also played a role. In the early 1980s in America the Reagan administration lifted most regulations pertaining to sweets and fast food advertising to children. As a result, the number of advertisements seen by the average child increased greatly, and a large proportion of these were for fast food and sweets.

- Changes in *the price of petrol* (i.e. gasoline) are also believed to have had an effect, as unlike during the 1970s it is now affordable in the United States to drive everywhere — at a time when public transit goes underused. At the same time more areas have been built without sidewalks and parks.

- The *changing workforce* as each year a greater percent of the population spends their entire workday behind a desk or computer, seeing virtually no exercise. In the kitchen the microwave oven has seen sales of calorie-dense frozen convenience foods skyrocket and has encouraged more elaborate snacking.

- A social cause that is believed by many to play a role is the increasing number of *two income households* in which one parent no longer remains home to look after the house. This increases the number of restaurant and take-out meals.

- *Urban sprawl* may be a factor: obesity rates increase as urban sprawl increases, possibly due to less walking and less time for cooking.

- Since 1980 both sit-in and *fast food restaurants* have seen dramatic growth in terms of the number of outlets and customers served. Low food costs, and intense competition for market share, led to increased portion sizes — for example, McDonalds french fries portions rose from 200 Calories (840 kilojoules) in 1960 to over 600 Calories (2,500 kJ) today.

- *Increased food production* is a probable factor. The U.S. produces three times more food than U.S. residents eat.

- Increasing *affluence* itself (including many of the above factors as accompaniments of affluence) may be a cause, or contributing factor since obesity tends to flourish as a disease of affluence in countries which are developing and becoming westernised . This is supported by a dip in American GDP after 1990, followed by a substantial increase. U.S. obesity statistics followed the same pattern, offset by two years.

- An aging population may also be a major factor, as the likelihood of becoming obese increases with age. Beyond their twenties, the older a person becomes the slower their metabolism becomes, reducing the amount of calories required to sustain the body, thus if a person does not reduce their intake of food with age, they will become obese over time. As the average age of individuals within a society increases, the rate of obesity also increases. This situation is exacerbated by the baby boom generation, which represents a disproportionately large portion of the population in many countries and is currently nearing the latter end of the typical lifespan in affluent nations, and therefore is in the high-risk zone for obesity.

Interestingly an increase in the number of Americans who exercise and diet occurred before the increase in obesity, and some scholars have even argued that these trends

actually encouraged obesity. Nearly all diets fail, with participants resuming their previous eating habits or even engaging in binge eating. Many then see an overall increase in their weight. If the diet is then repeated and abandoned again, a pattern of rising and falling weight is established, known as weight cycling. Similarly those who work out but then stop can end up being heavier than those who never exercised.

## Public health and policy responses

On top of controversies about the causes of obesity, and about its precise health implications, come policy controversies about the correct approach to obesity. The main debate is between "personal responsibility" advocates, who resist regulatory attempts to intervene in citizen's private dietary habits, and "public interest" advocates, who promote regulations, on the same public health grounds as the restrictions applied to tobacco products. In the U.S., a recent bout in this controversy involves the so-called Cheeseburger Bill, an attempt to indemnify food industry businesses from what some consider to be frivolous lawsuits by obese clients.

"Personal responsibility" advocates work on the basis that, as the microbiologist Rene Dubos once said, health ought not to be considered an end in itself, but "the condition best suited to reach goals that each individual formulates for himself" . Any other definition permits authorities to curtail the autonomy of the self-determining individual, imposing quantity over quality of life onto them, undermining his civil liberties. As much as principled doctors, personal responsibility arguments have also been offered by food producer lobbies. In 1961, for example, as President John F Kennedy raised concerns about a lack of fitness in American society, a spokesman for the U.S. Dairy industry, Frank R. Neu, wrote advertorials warning *We May Be Sitting Ourselves To Death*. Not food regulation, but personal exercising, is mooted as the solution.

When it comes to childhood obesity, personal responsibility also means parental responsibility. A survey by the nonpartisan group Public Agenda found 68 percent of American parents said it was "absolutely essential" to teach their children good eating habits, but only 40 percent believe they had succeeded. Fewer parents say it is essential to teach their children about physical fitness (51 percent), but more believe they have succeeded (53 percent). Overall, parents said they found it difficult to protect their children from negative social messages on a range of topics, including bad nutrition.

On July 15, 2004, the United States Department of Health and Human Services announced a new policy from HHS' Centers for Medicare & Medicaid Services (CMS) removing language in the Medicare Coverage Issues Manual stating that obesity is not an illness. According to the press release "This step allows members of the public to request that Medicare review medical evidence to determine whether specific treatments related to obesity would be covered by Medicare. By law, Medicare covers specified medically necessary services for illness and injury. The prior manual language, because it stated that obesity was not an illness, could prevent Medicare from covering treatments for diseases related to obesity

# Diabetes mellitus

| **Diabetes mellitus**<br>*Classifications and external resources* | |
|---|---|
| **ICD-10** | E10. — E14. |
| **ICD-9** | 250 |
| **MedlinePlus** | 001214 |
| **eMedicine** | med/546 emerg/134 |
| **MeSH** | *C18.452.394.750* |

*For the disease characterized by excretion of large amounts of severely diluted urine, see diabetes insipidus. For diabetes mellitus in pets, see diabetes in cats and dogs.*

**Diabetes mellitus** is a disorder of carbohydrate metabolism. It is a disease characterized by persistent hyperglycemia (high blood sugar levels). It is a metabolic disease that requires medical diagnosis, treatment and lifestyle changes. The World Health Organization recognizes three main forms of diabetes: *type 1*, *type 2* and *gestational diabetes* (or *type 3*, occurring during pregnancy), although these three "types" of diabetes are more accurately considered patterns of pancreatic failure rather than single diseases. Type 1 is due to autoimmune destruction of the insulin-producing cells, while type 2 and gestational diabetes are due to insulin resistance by tissues. Type 2 may progress to destruction of the insulin producing cells of the pancreas, but is still considered Type 2, even though insulin administration may be required..

Since the first therapeutic use of insulin (1921) diabetes has been a treatable but chronic condition, and the main risks to health are its characteristic long-term complications. These include cardiovascular disease (doubled risk), chronic renal failure (it is the main cause for dialysis in developed world adults), retinal damage which can lead to blindness and is the most significant cause of adult blindness in the non-elderly in the developed world, nerve damage, erectile dysfunction (impotence), to gangrene with risk of amputation of toes, feet, and even legs.

# Terminology

The term *diabetes* (Greek: *διαβήτης*) was coined by Aretaeus of Cappadocia. It is derived from the Greek *διαβαίνειν*, *diabaínein* that literally means "passing through," or "siphon," a reference to one of diabetes' major symptoms—excessive urine production. In 1675 Thomas Willis added *mellitus* from the Latin word for honey (*mel* in the sense of "honey sweet") when he noted that the blood and urine of a diabetic has a sweet taste. This had been noticed long before in ancient times by the Greeks, Chinese, Egyptians, and Indians. In 1776 it was confirmed the sweet taste was because of an excess of a kind of sugar in the urine and blood of people with diabetes.

The ancient Indians tested for diabetes by observing whether ants were attracted to a person's urine, and called the ailment "sweet urine disease" (Madhumehalai); medieval European doctors tested for it by tasting the urine themselves, a scene which was occasionally depicted in Gothic reliefs.

While the term *diabetes* without a modifier usually refers to diabetes mellitus, there is another, rarer condition named diabetes insipidus (unquenchable diabetes) in which the urine is not sweet; it can be caused by either kidney (nephrogenic DI) or pituitary gland (central DI) damage.

# History

Although diabetes has been recognized since antiquity, and treatments of various efficacy have been known in various regions since the Middle Ages, and in legend for much longer, the elucidation of the pathogenesis of diabetes occurred mainly in the 20th century.

**Diabetes mellitus**

**Types of Diabetes**

Diabetes mellitus type 1
Diabetes mellitus type 2
Gestational diabetes

**Pre-diabetes:**

Impaired fasting glycaemia

Impaired glucose tolerance

**Disease Management**

Diabetes management:
•Diabetic diet
•Anti-diabetic drugs
•Conventional insulinotherapy
•Intensive insulinotherapy

**Other Concerns**

Cardiovascular disease

Diabetic comas:

•Diabetic hypoglycemia

•Diabetic ketoacidosis

•Nonketotic hyperosmolar

Diabetic myonecrosis

Diabetic nephropathy

Diabetic neuropathy

Diabetic retinopathy

Diabetes and pregnancy

**Blood tests**

Fructosamine
Glucose tolerance test
Glycosylated hemoglobin

The discovery of the role of the pancreas in diabetes is generally ascribed to Joseph von Mering and Oskar Minkowski, European researchers who in 1889 found that when they completely removed the pancreas of dogs, the dogs developed all the signs and symptoms of diabetes and died shortly afterward. In 1910, Sir Edward Albert Sharpey-Schafer of Edinburgh suggested that people with diabetes were deficient in a single chemical that was normally produced by the pancreas—he proposed calling this substance *insulin*. The term is derived from the Latin *insula*, meaning island, in reference to the islets of Langerhans in the pancreas that produce insulin.

The endocrine role of the pancreas in metabolism, and indeed the existence of insulin, was not fully clarified until 1921, when Sir Frederick Grant Banting and Charles Herbert Best repeated the work of Von Mering and Minkowski, but went further and demonstrated that they could reverse induced diabetes in dogs by giving them an extract from the pancreatic islets of Langerhans of healthy dogs. Banting, Best, and colleagues (particularly the chemist Collip) went on to isolate the hormone insulin from bovine pancreases at the University of Toronto in Canada. This led to the availability of an effective treatment—insulin injections—and the first clinical patient was treated in 1922. For this, Banting and MacLeod received the Nobel Prize in Physiology or Medicine in 1923; both shared their Prize money with others in the team who were not recognized, in particular Best and Collip. Banting and Best made the patent available without charge and did not attempt to control commercial production. Insulin production and therapy rapidly spread around the world, largely as a result of this decision.

Despite the availability of treatment, diabetes remained a major cause of death. For instance, statistics reveal that the cause-specific mortality rate during 1927 amounted to about 47.7 per 100,000 population in Malta.

The distinction between what is now known as type 1 diabetes and type 2 diabetes was first clearly made by Sir Harold Percival (Harry) Himsworth in 1935 and was published in January 1936.

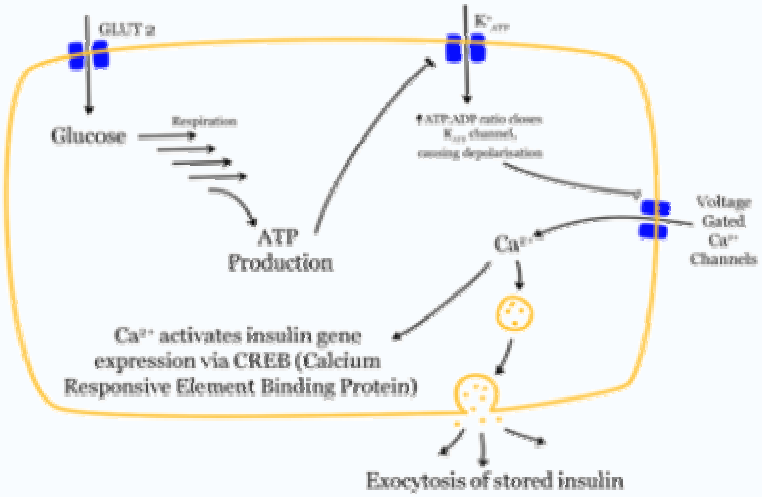
Other landmark discoveries include:

- identification of the first of the sulfonylureas in 1942
- the radioimmunoassay for insulin, as discovered by Rosalyn Yalow and Solomon Berson (gaining Yalow the 1977 Nobel Prize in Physiology or Medicine)
- Dr Gerald Reaven's identification of the constellation of symptoms now called metabolic syndrome in 1988

- Demonstration that intensive glycemic control in type 1 diabetes reduces chronic side effects more as glucose levels approach 'normal' in a large longitudinal study, and also in type 2 diabetics in other large studies
- identification of the first thiazolidinedione as an effective insulin sensitizer during the 1990's
- Self monitoring of glucose in the home via a finger-stick blood sample and a battery powered meter in the 1970's.

# Causes & types

## Glucose metabolism




Mechanism of insulin release in normal pancreatic beta cells (that is, glucose dependence). Insulin secretion does not depend on blood glucose levels; it is stored pending release which does depend on blood glucose levels.

Since insulin is the principal hormone that regulates uptake of glucose into most cells from the blood (primarily muscle and fat cells, but not central nervous system cells), deficiency of insulin or the insensitivity of its receptors plays a central role in all forms of diabetes mellitus.

Much of the carbohydrate in food is converted within a few hours to the monosaccharide glucose, the principal carbohydrate in blood. Some carbohydrates are not; fruit sugar (fructose) is usable as cellular fuel but is not converted to glucose and does not participate in the insulin / glucose metabolic regulatory mechanism, nor does the carbohydrate cellulose (though it is actually many glucoses in long chains) as humans and many animals have no digestive pathway capable of handling it. Insulin is released

into the blood by beta cells (β-cells) in the pancreas in response to rising levels of blood glucose (e.g., after a meal). Insulin enables most body cells (about 2/3 is the usual estimate, including muscle cells and adipose tissue) to absorb glucose from the blood for use as fuel, for conversion to other needed molecules, or for storage. Insulin is also the principal control signal for conversion of glucose (the basic sugar used for fuel) to glycogen for internal storage in liver and muscle cells. Reduced insulin levels result both in the reduced release of insulin from the beta cells and in the reverse conversion of glycogen to glucose when glucose levels fall, although only glucose thus recovered by the liver re-enters the bloodstream as muscle cells lack the necessary export mechanism.

Higher insulin levels increase many anabolic ("building up") processes such as cell growth and duplication, protein synthesis, and fat storage. Insulin is the principal signal in converting many of the bidirectional processes of metabolism from a catabolic to an anabolic direction, and vice versa. In particular, it is the trigger for entering or leaving ketosis (ie, the fat burning metabolic phase).

If the amount of insulin available is insufficient, if cells respond poorly to the effects of insulin (insulin insensitivity or resistance), or if the insulin itself is defective, glucose will not be handled properly by body cells (about ⅔ require it) or stored appropriately in the liver and muscles. The net effect is persistent high levels of blood glucose, poor protein synthesis, and other metabolic derangements, such as acidosis.

## Type 1 diabetes mellitus

*Diabetes mellitus type 1*

Type 1 diabetes mellitus - formerly known as insulin-dependent diabetes (IDDM), childhood diabetes, or juvenile-onset diabetes - is characterized by loss of the insulin-producing beta cells of the islets of Langerhans of the pancreas leading to a deficiency of insulin. Sensitivity and responsiveness to insulin are usually normal, especially in the early stages. This type comprises up to 10% of total cases in North America and Europe, though this varies by geographical location. This type of diabetes can affect children or adults, but has traditionally been termed "juvenile diabetes" because it represents a majority of cases of diabetes affecting children. The most common cause of beta cell loss leading to type 1 diabetes is autoimmune destruction, accompanied by antibodies directed against insulin and islet cell proteins. The principal treatment of type 1 diabetes, even

from the earliest stages, is replacement of insulin. Without insulin, ketosis and diabetic ketoacidosis can develop and coma or death will result.

Currently, type 1 diabetes can be treated only with insulin, with careful monitoring of blood glucose levels using blood testing monitors. Emphasis is also placed on lifestyle adjustments (diet and exercise). Apart from the common subcutaneous injections, it is also possible to deliver insulin via a pump, which allows infusion of insulin 24 hours a day at preset levels, and the ability to program a push dose (a bolus) of insulin as needed at meal times. This is at the expense of an indwelling subcutaneous catheter. It is also possible to deliver insulin via an inhaled powder.

Type 1 treatment must be continued indefinitely at present. Treatment does not impair normal activities, if sufficient awareness, appropriate care, and discipline in testing and medication. The average glucose level for the type 1 patient should be as close to normal (80–120 mg/dl, 4–6 mmol/l) as possible. Some physicians suggest up to 140–150 mg/dl (7-7.5 mmol/l) for those having trouble with lower values, such as frequent hypoglycemic events. Values above 200 mg/dl (10 mmol/l) are often accompanied by discomfort and frequent urination leading to dehydration. Values above 300 mg/dl (15 mmol/l) usually require immediate treatment and may lead to ketoacidosis. Low levels of blood glucose, called hypoglycemia, may lead to seizures or episodes of unconsciousness.

## Type 2 diabetes mellitus

*Diabetes mellitus type 2*

Type 2 diabetes mellitus - previously known as adult-onset diabetes, maturity-onset diabetes, or non-insulin dependent diabetes mellitus (NIDDM) - is due to a combination of defective insulin secretion and defective responsiveness to insulin (often termed insulin resistance or reduced insulin sensitivity), almost certainly involving the insulin receptor in cell membranes. In early stages, the predominant abnormality is reduced insulin sensitivity, characterized by elevated levels of insulin in the blood. In the early stages, hyperglycemia can be reversed by a variety of measures and medications that improve insulin sensitivity or reduce glucose production by the liver, but as the disease progresses the impairment of insulin secretion worsens, and therapeutic replacement of insulin often becomes necessary. There are numerous theories as to the exact cause and mechanism for this resistance, but central obesity (fat concentrated around the waist in relation to abdominal organs, not it seems, subcutaneous fat) is known to predispose for

insulin resistance, possibly due to its secretion of adipokines (a group of hormones) that impair glucose tolerance. Abdominal fat is especially active hormonally. Obesity is found in approximately 90% of Developed world patients diagnosed with type 2 diabetes. Other factors may include aging and family history, although in the last decade it has increasingly begun to affect children and adolescents.

Type 2 diabetes may go unnoticed for years in a patient before diagnosis, since the symptoms are typically milder (eg, lack of ketoacidotic episodes) and can be sporadic. However, severe complications can result from unnoticed type 2 diabetes, including renal failure, vascular disease (including coronary artery disease), vision damage, etc.

Type 2 diabetes is usually first treated by changes in physical activity (usually increase), diet (generally decrease carbohydrate intake, especially glucose generating carbohydrates), and through weight loss. These can restore insulin sensitivity, even when the weight loss is modest, for example, around 5 kg (10 to 15 lb), most especially when it is in abdominal fat deposits. The next step, if necessary, is treatment with oral antidiabetic drugs. As insulin production is initially unimpaired, oral medication (often used in combination) can still be used that improves insulin production (eg, sulfonylureas) and regulate inappropriate release of glucose by the liver (and attenuate insulin resistance to some extent (eg, metformin), and substantially attenuate insulin resistance (eg, thiazolidinediones). If these fail, insulin therapy will be necessary to maintain normal or near normal glucose levels. A disciplined regimen of blood glucose checks is recommended in most cases, most particularly and necessarily when taking most of these medications.

## Gestational diabetes

*Gestational diabetes*

Gestational diabetes, Type 3, also involves a combination of inadequate insulin secretion and responsiveness, resembling type 2 diabetes in several respects. It develops during pregnancy and may improve or disappear after delivery. Even though it may be transient, gestational diabetes may damage the health of the fetus or mother, and about 20%–50% of women with gestational diabetes develop type 2 diabetes later in life.

*Gestational diabetes mellitus* occurs in about 2%–5% of all pregnancies. It is temporary, and fully treatable, but, if untreated, may cause problems with the pregnancy, including

macrosomia (high birth weight) of the child. It requires careful medical supervision during the pregnancy.

## Other types

There are several rare causes of diabetes mellitus that do not fit into type 1, type 2, or gestational diabetes:

- Genetic defects in beta cells (autosomal or mitochondrial)
- Genetically-related insulin resistance, with or without lipodystrophy (abnormal body fat deposition)
- Diseases of the pancreas (e.g. chronic pancreatitis, cystic fibrosis)
- Hormonal defects
- Chemicals or drugs

The tenth version of the International Statistical Classification of Diseases (ICD-10) contained a diagnostic entity named "malnutrition-related diabetes mellitus" (MRDM or MMDM, ICD-10 code E12). A subsequent WHO 1999 working group recommended that MRDM be deprecated, and proposed a new taxonomy for alternative forms of diabetes. Classifications of non-type 1, non-type 2, non-gestational diabetes remains controversial.

## Genetics

Both type 1 and type 2 diabetes are at least partly inherited. Type 1 diabetes appears to be triggered by some (mainly viral) infections, or in a less common group, by stress or environmental factors (such as exposure to certain chemicals or drugs). There is a genetic element in individual susceptibility to some of these triggers which has been traced to particular HLA genotypes (i.e. genetic "self" identifiers used by the immune system). However, even in those who have inherited the susceptibility, type 1 diabetes mellitus seems to require an environmental trigger. A small proportion of people with type 1 diabetes carry a mutated gene that causes maturity onset diabetes of the young (MODY).

There is a rather stronger inheritance pattern for type 2 diabetes. Those with first-degree relatives with type 2 have a much higher risk of developing type 2. Concordance among monozygotic twins is close to 100%, and 25% of those with the disease have a family history of diabetes. It is also often connected to obesity, which is found in approximately 85% of (North American) patients diagnosed with this type, so some experts believe that inheriting a tendency toward obesity also contributes.

# Diagnosis

## Signs and symptoms

The classical triad of diabetes symptoms is polyuria (frequent urination), polydipsia (increased thirst, and consequent increased fluid intake) and polyphagia (increased appetite). These symptoms may develop quite fast in type 1, particularly in children (weeks or months), but may be subtle or completely absent - as well as developing much more slowly - in type 2. In type 1 there may also be weight loss (despite normal or increased eating), increased appetite, and irreducible fatigue. These symptoms may also manifest in type 2 diabetes in patients whose diabetes is poorly controlled.

Thirst develops because of osmotic effects—sufficiently high glucose (above the "renal threshold") in the blood is excreted by the kidneys, but this requires water to carry it and causes increased fluid loss, which must be replaced. The lost blood volume will be replaced from water held inside body cells, causing dehydration. Prolonged high blood glucose causes changes in the shape of the lens in the eye, leading to vision changes. Blurred vision is a common complaint leading to a diagnosis of type 1; it should always be suspected in such cases.

Patients (usually with type 1 diabetes) may also present with diabetic ketoacidosis (DKA), an extreme state of dysregulation characterized by the smell of acetone on the patient's breath, Kussmaul breathing (a rapid, deep breathing), polyuria, nausea, vomiting and abdominal pain and any of many altered state of consciousness or arousal (eg, hostility and mania or, equally, confusion and lethargy). In severe DKA, coma (unconsciousness) may follow, progressing to death if untreated. In any form, DKA is a medical emergency and requires expert attention.

A rarer but equally severe presentation is hyperosmolar nonketotic state, which is more common in type 2 diabetes, and is mainly the result of dehydration due to the polyuria. Often, the patient has been drinking extreme amounts of sugar-containing drinks, leading to a vicious circle in regard to water loss.

## Diagnostic approach

The diagnosis of type 1 diabetes and many cases of type 2 is usually prompted by recent-onset symptoms of excessive urination (*polyuria*) and excessive thirst (*polydipsia*), often

accompanied by weight loss. These symptoms typically worsen over days to weeks; about 25% of people with new type 1 diabetes have developed a degree of diabetic ketoacidosis by the time the diabetes is recognized. The diagnosis of other types of diabetes is usually made in many other ways. The most common are (1) health screening, (2) detection of hyperglycemia when a doctor is investigating a complication of longstanding, unrecognized diabetes, and (3) new signs and symptoms attributable to the diabetes.

1. Diabetes screening is recommended for many types of people at various stages of life or with several different risk factors. The screening test varies according to circumstances and local policy and may be a random glucose, a fasting glucose and insulin, a glucose two hours after 75 g of glucose, or a formal glucose tolerance test. Many healthcare providers recommend universal screening for adults at age 40 or 50, and sometimes occasionally thereafter. Earlier screening is recommended for those with risk factors such as obesity, family history of diabetes, high-risk ethnicity (Hispanic/Latin American, American Indian, African American, Pacific Island, and South Asian ancestry).
2. Many medical conditions are associated with a higher risk of various types of diabetes and warrant screening. A partial list includes: high blood pressure, elevated cholesterol levels, coronary artery disease, past gestational diabetes, polycystic ovary syndrome, chronic pancreatitis, fatty liver, hemochromatosis, cystic fibrosis, several mitochondrial neuropathies and myopathies, myotonic dystrophy, Friedreich's ataxia, some of the inherited forms of neonatal hyperinsulinism, and many others. Risk of diabetes is higher with chronic use of several medications, including high-dose glucocorticoids, some chemotherapy agents (especially L-asparaginase), and some of the antipsychotics and mood stabilizers (especially phenothiazines and some atypical antipsychotics).
3. Diabetes is often detected when a person suffers a problem frequently caused by diabetes, such as a heart attack, stroke, neuropathy, poor wound healing or a foot ulcer, certain eye problems, certain fungal infections, or delivering a baby with macrosomia or hypoglycemia.

## Diagnostic criteria

Diabetes mellitus is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following:

- fasting plasma glucose level at or above 126 mg/dL or 7.0 mmol/l.
- plasma glucose at or above 200 mg/dL or 11.1 mmol/l two hours after a 75 g oral glucose load in a glucose tolerance test.
- random plasma glucose at or above 200 mg/dL or 11.1 mmol/l.

A positive result should be confirmed by any of the above-listed methods on a different day, unless there is no doubt as to the presence of significantly-elevated glucose levels. Most physicians prefer measuring a fasting glucose level because of the ease of measurement and time commitment of formal glucose tolerance testing, which can take two hours to complete. By definition, two fasting glucose measurements above 126 mg/dL or 7.0 mmol/l is considered diagnostic for diabetes mellitus.

Patients with fasting sugars between 6.1 and 7.0 mmol/l (110 and 125 mg/dL) are considered to have "impaired fasting glucose" and patients with plasma glucose at or above 140mg/dL or 7.8 mmol/l two hours after a 75 g oral glucose load are considered to have "impaired glucose tolerance". "Prediabetes" is either impaired fasting glucose or impaired glucose tolerance; the latter in particular is a major risk factor for progression to full-blown diabetes mellitus as well as cardiovascular disease.

While not used for diagnosis, an elevated level of glucose bound to hemoglobin (termed glycosylated hemoglobin or *HbA1c*) of 6.0% or higher (2003 revised U.S. standard) is considered abnormal by most labs; HbA1c is primarily a treatment-tracking test reflecting average blood glucose levels over the preceding 90 days (approximately). However, some physicians may order this test at the time of diagnosis to track changes over time. The current recommended goal for HbA1c in patients with diabetes is <7.0%, as defined as "good glycemic control", although some guidelines are stricter (<6.5%). People with diabetes that have HbA1c levels within this goal have a significantly lower incidence of complications from diabetes, including retinopathy and diabetic nephropathy.

# Complications

The complications are far less common and less severe in people who have well-controlled blood sugar levels.  In fact, the better the control, the lower the risk of complications. Hence patient education, understanding and participation is vital. Healthcare professionals who treat diabetes also address other health problems that may accelerate the deleterious effects of diabetes. These include smoking (abstain), elevated cholesterol levels (control with diet, exercise or medication), obesity (even modest weight loss can be beneficial), high blood pressure, and lack of regular exercise.

### Acute

*Main articles: Diabetic ketoacidosis , Nonketotic hyperosmolar coma , Hypoglycemia , and Diabetic coma*

Diabetic ketoacidosis

*Diabetic ketoacidosis* (DKA) is an acute, dangerous complication and is always a *medical emergency*. On presentation at hospital, the patient in DKA is typically dehydrated and breathing both fast and deeply. Abdominal pain is common and may be severe. The level of consciousness is normal until late in the process, when lethargy (dulled or reduced level of alertness or consciousness) may progress to coma. The ketoacidosis can become severe enough to cause hypotension and shock. Prompt proper treatment usually results in full recovery, though death can result from inadequate treatment, delayed treatment or from a variety of complications. It is much more common in type 1 diabetes than type 2, but can still occur in patients with type 2 diabetes.

Nonketotic hyperosmolar coma

While not always progressing to coma, this *hyperosmolar nonketotic state* (HNS) is another acute problem associated with diabetes mellitus. It has many symptoms in common with DKA, but a different cause, and requires different treatment. In anyone with very high blood glucose levels (usually considered to be above 300 mg/dl or 16 mmol/l), water will be osmotically driven out of cells into the blood. The kidneys will also be "dumping" glucose into the urine, resulting in concomitant loss of water, causing an increase in blood osmolality. If the fluid is not replaced (by mouth or intravenously), the osmotic effect of high glucose levels combined with the loss of water will eventually result in such a high serum osmolality (dehydration). The body's cells may become progressively dehydrated as water is drawn out from them and excreted. Electrolyte imbalances are also common. This combination of changes, especially if prolonged, will result in symptoms of lethargy (dulled or reduced level of alertness or consciousness) and may progress to coma. As with DKA urgent medical treatment is necessary, especially volume replacement. This is the diabetic coma which more commonly occurs in type 2 diabetics.

Hypoglycemia

*Hypoglycemia*, or abnormally low blood glucose, is a complication of several diabetes treatments. It may develop if the glucose intake does not match the treatment. The patient may become agitated, sweaty, and have many symptoms of sympathetic activation of the autonomic nervous system resulting in feelings similar to dread and immobilized panic.

Consciousness can be altered, or even lost, in extreme cases, leading to coma and/or seizures or even brain damage and death. In patients with diabetes this can be caused by several factors, such as too much or incorrectly timed insulin, too much exercise or incorrectly timed exercise (which decreases insulin requirements) or not enough food or insufficient amount of carbohydrates in food. In most cases, hypoglycemia is treated with sweet drinks or food. In severe cases, an injection of glucagon (a hormone with the opposite effects of insulin) or an intravenous infusion of glucose is used for treatment, but usually only if the diabetic is unconscious.

## Chronic

Microvascular disease

Chronic elevation of blood glucose level leads to damage of blood vessels. In diabetes, the resultant problems are grouped under "microvascular disease" (due to damage to small blood vessels) and "macrovascular disease" (due to damage to the arteries).

The damage to small blood vessels leads to a microangiopathy, which causes the following organ-related problems:

- *Diabetic retinopathy*, growth of friable and poor-quality new blood vessels in the retina as well as macular edema (swelling of the macula), which can lead to severe vision loss or blindness. Retinal damage (from microangiopathy) makes it the most common cause of blindness among non-elderly adults in the US.
- *Diabetic neuropathy*, abnormal and decreased sensation, usually in a stocking distribution starting at the feet but potentially in other nerves. When combined with damaged blood vessels this can lead to *diabetic foot* (see below). Other forms of diabetic neuropathy may present as mononeuritis or autonomic neuropathy.
- *Diabetic nephropathy*, damage to the kidney which can lead to chronic renal failure, eventually requiring dialysis. Diabetes mellitus is the most common cause of adult kidney failure worldwide.

Macrovascular disease

Macrovascular disease leads to cardiovascular disease, mainly by accelerating atherosclerosis:

- Coronary artery disease, leading to myocardial infarction ("heart attack") or angina
- Stroke (mainly ischemic type)

- Peripheral vascular disease, which contributes to intermittent claudication (exertion-related foot pain) as well as diabetic foot.
- Diabetic myonecrosis

Diabetic foot, often due to a combination of neuropathy and arterial disease, may cause skin ulcer and infection and, in serious cases, necrosis and gangrene. It is the most common cause of adult amputation, usually of toes and or feet, in the US and other Western countries.

Carotid artery stenosis does not occur more often in diabetes, and there appears to be a lower prevalence of abdominal aortic aneurysm. However, diabetes does cause higher morbidity, mortality and operative risks with these conditions.

# Treatment and management

*Diabetes management*

Diabetes is a chronic disease, and emphasis is on managing short-term as well as long-term diabetes-related problems. There is an important role for patient education, nutritional support, self glucose monitoring, as well as long-term glycemic control. A scrupulous control is needed to help reduce the risk of long term complications. In addition, given the associated higher risks of cardiovascular disease, lifestyle modifications must be implemented to control blood pressure and cholesterol by exercising more, smoking cessation, and consuming an appropriate diet.

In countries with a general practitioner system, such as the United Kingdom, care may be extended mainly in the community, with hospital-based specialist input only in case of complications, difficult blood sugar control, or participation in research. In other circumstances, general practitioners and specialists may share care of a patient in a team approach. Optometrists, podiatrists/chiropodists, dietitians, physiotherapists, clinical nurse specialists (eg, Certified Diabetic Educators), or nurse practitioners may provide multidisciplinary expertise.

Nowadays, with improved diagnostic support, type-1 (insulin-dependent) diabetics can join all kinds of activities. In May 2006 for example, the Austrian mountaineer Geri Winkler became the first insulin-dependent diabetic to reach the top of Mount Everest.

# Curing diabetes

The fact that type 1 diabetes is due to the failure of one of the cell types of a single organ with a relatively simple function (i.e. the failure of the islets of Langerhans) has led to the study of several possible schemes to cure diabetes. In contrast, type 2 diabetes is more complex with fewer prospects of a curative measure, but further understanding of the underlying mechanism of insulin resistance may make a cure possible. Correcting insulin resistance may provide a cure for type 2 diabetes.

Only those type 1 diabetics who have received a kidney-pancreas transplant (when they have developed diabetic nephropathy) and become insulin-independent may be considered "cured" from their diabetes. Still, they generally remain on long-term immunosuppressive drug and there is a possibility the autoimmune phenomenon will develop in the transplanted organ.

Transplants of exogenous beta cells have been performed experimentally in both mice and humans, but this measure is not yet practical in regular clinical practice. Thus far, like any such transplant, it provokes an immune reaction and long-term immunosuppressive drug will be needed to protect the transplanted tissue. An alternative technique has been proposed to place the transplanted beta cells in a semi-permeable container, isolating them from the immune system. Stem cell research has also been suggested as a potential avenue for a cure since it may permit the regrowth of islet cells which are genetically part of the treated individual, thus eliminating the need for immuno-suppressants. However, it has also been hypothesised that the same mechanism which led to islet destruction originally may simply destroy even stem-cell regenerated islets.

Microscopic or nanotechnological approaches are under investigation as well, with implanted stores of insulin metered out by a rapid response valve sensitive to blood glucose levels. At least two approaches have been proposed and demonstrated in vitro. These are, in some sense, closed-loop insulin pumps.

# Prevention

As little is known on the exact mechanism by which type 1 diabetes develops, there are no preventive measures available for that form of diabetes. Some studies have attributed a protective effect of breastfeeding on the development of type 1 diabetes. In addition,

breastfeeding might also be correlated with the prevention of type 2 of the disease in mothers.

Type 2 diabetes can be prevented in part by maintaining a stable body weight through diet and exercise. Some studies have shown delayed progression to diabetes in predisposed patients through the use of metformin or valsartan.

## Public health and policy

The 1989 Declaration of St Vincent was the result of international efforts to improve the care accorded to those with diabetes. Doing so is important both in terms of quality of life and life expectancy but also economically - expenses to diabetes have been shown to be a major drain on health- and productivity-related resources for healthcare systems and governments.

Several countries established more and less successful national diabetes programmes to improve treatment of the disease.

## Epidemiology and statistics

In 2006, according to the World Health Organization, at least 171 million people worldwide suffer from diabetes. Its incidence is increasing rapidly, and it is estimated that by the year 2030, this number will double. Diabetes mellitus occurs throughout the world, but is more common (especially type 2) in the more developed countries. The greatest increase in prevalence is, however, expected to occur in Asia and Africa, where most patients will likely be found by 2030. The increase in incidence of diabetes in developing countries follows the trend of urbanization and lifestyle changes, perhaps most importantly a "Western-style" diet. This has suggested an environmental (i.e., dietary) effect, but there is little understanding of the mechanism(s) at present, though there is much speculation, some of it most compellingly presented.

Diabetes is in the top 10, and perhaps the top 5, of the most significant diseases in the developed world, and is gaining in significance there and elsewhere (see big killers).

For at least 20 years, diabetes rates in North America have been increasing substantially. In 2005 there are about 20.8 million people with diabetes in the United States alone. According to the American Diabetes Association, there are about 6.2 million people

undiagnosed and about 41 million people that would be considered prediabetic. However, the criteria for diagnosing diabetes in the USA means that it is more readily diagnosed than in some other countries. The Centers for Disease Control has termed the change an epidemic. The National Diabetes Information Clearinghouse estimates that diabetes costs $132 billion in the United States alone every year. About 5%–10% of diabetes cases in North America are type 1, with the rest being type 2. The fraction of type 1 in other parts of the world differs; this is likely due to both differences in the rate of type 1 and differences in the rate of other types, most prominently type 2. Most of this difference is not currently understood.According to the American Diabetes Association, 1 in 3 Americans born after 2000 will develop diabetes in their lifetime

# Eating disorder

An **eating disorder** is a complex compulsion to eat in a way which disturbs physical and psychological health. The eating may be excessive (compulsive over-eating); too limited (restricting); may include normal eating punctuated with episodes of purging; may include cycles of binging and purging; or may encompass the ingesting of non-foods. The best-known eating disorders are Anorexia nervosa and Bulimia nervosa. The most widely and rapidly spreading eating disorder is compulsive overeating or Binge eating disorder. The three most common eating disorders are anorexia, bulimia and binge eating disorder. All three have severe consequences to a person's health and can even cause death. There are numerous theories as to the causes and mechanisms leading to eating disorders.

## Types

- Anorexia nervosa
- Binge eating disorder
- Bulimia nervosa
- Eating disorder not otherwise specified
- Hyperphagia
- Rumination
- Pica

Eating disorders are characterized by an abnormal obsession with food and weight. Eating disorders are much more common in women than in men, particularly teenaged

girls, where eating disorders are on the rise. Over 50% of the people with an eating disorder also have a comorbid diagnosis of severe mental depression. The American Psychiatric Association lists eating disorders. Some psychologists also classify a syndrome called orthorexia as an eating disorder, or, more properly, "disordered eating" - the person is overly obsessed with the consumption of what they see as the 'right' foods for them, to the point that their nutrition and quality of life suffers (although due to cultural and political factors which influence food choices, this idea is considered controversial by some). In addition, some individuals have food phobias about what they can and cannot eat, which can be characterised as an eating disorder. Somewhat qualitatively different from those conditions previously mentioned is pica, or the habitual ingestion of inedibles, such as dirt, wood, hair, etc. This is a condition particularly prevalent in children.