Additional Reading

Renewable energy in Germany

The share of electricity produced from renewable energy in Germany has increased from 6. 3 percent of the national total in 2000 to over 20 percent in the first half of 2011. In 2010, investments totaling 26 billion Euros were made in Germany’s renewable energies sector.

According to official figures, some 370,000 people in Germany were employed in the renewable energy sector in 2010, especially in small and medium sized companies. This is an increase of around 8 percent compared to 2009 (around 339,500 jobs), and well over twice the number of jobs in 2004 (160,500). About two-thirds of these jobs are attributed to the Renewable Energy Sources Act. Germany is the world's first major renewable energy economy. In 2010 nearly 17 % (more than 100 kW h – kilowatt hour) of Germany's electricity supply (603 kW h) was produced from renewable energy sources, more than the 2010 contribution of gas fired power plants.

Renewable electricity in 2010 was 101.7 kW h including wind power 36.5 kW h, biomass and biowaste 33.5 kW h, hydropower 19.7 kW h and photovoltage solar power 12.0 kW h.

Germany's renewable energy sector is among the most innovative and successful worldwide (fig1). Nordex, Repower, Fuhrländer and Enercon are wind power companies based in Germany. SolarWorld, Q-Cells and Conergy are solar power companies based in Germany. These companies dominate the world market. Every third solar panel and every second wind rotor is made in Germany, and German turbines and generators used in hydro energy generation are among the most popular worldwide.

Fig. 1. Renewable electric power produced
in Germany in 2009 (by energy source)

Nearly 800,000 people work in the German environment technology sector; an estimated 214,000 people work with renewables in Germany, up from 157,000 in 2004, an increase of 36 percent.

Siemens chief executive, Peter Löscher believes that Germany’s target of generating 35 per cent of its energy from renewables by 2020 is achievable – and, most probably, profitable for Europe’s largest engineering company. Its “environmental solutions” portfolio, which is firmly focused on renewables, is “already generating more than € 27 billion a year, 35 per cent of Siemens’ total revenue, and the plan is to grow this to € 40 billion by 2015”. Ending its involvement in nuclear industry will boost the credibility of Siemens as a purveyor of “green technology”.

Germany's main competitors in solar electricity are Japan, the US and China. In the wind industry it is Denmark, Spain and the US.

Renewable energy targets in Germany

Since the passage of the Directive on Electricity Production from Renewable Energy Sources in 1997, Germany and the other states of the European Union have been working towards a target of 12 % renewable electricity by 2010. Germany passed this target early in 2007 when the renewable energy share in electricity consumption in Germany reached 14 %. In September 2010 the German government announced the following new aggressive energy targets:

* Renewable electricity – 35 % by 2020 and 80 % by 2050.
* Renewable energy – 18 % by 2020, 30 % by 2030, and 60 % by 2050.
* Energy efficiency – cutting the national electrical consumption 50 % below 2008 levels by 2050.

The German Government reports that in 2010 renewable energy (mainly wind turbines and biomass plants) generated more than 100 kW h (billion kilowatt-hours) of electricity, providing nearly 17 % of the 600 kW h of electricity supplied.

Wind power

Closely after the USA, Germany is the world's second largest user of wind power with an installed capacity of 23,903 MW by the end of 2008, ahead of Spain which had an installed capacity of 16,740 MW (megawatt). 20,301 wind turbines are located in the German federal area and the country has plans to build more wind turbines.

In 2009, 6.5 % of Germany's total electricity consumption was satisfied by wind power. 867 wind power plants were constructed in 2008, and 952 more in 2009. At the end of 2009, Germany possessed 21,614 wind power plants. Their installed electricity production capacity was 25,777 MW.

Wind power currently produces about seven percent of Germany's total power and it is saidthat no other country has more technological know-how in this area. Wind power in Germany provides over 70,000 people with jobs and German wind energy systems are also exported. However, the economics of wind power in Germany are under close scrutiny and there are other issues which deserve consideration. These include the effects of wind turbines on the landscape, the bird population, and the tourist industry.

Following the 2011 Japanese nuclear accidents, Germany's federal government is working on a new plan for increasing energy efficiency and renewable energy commercialization, with a particular focus on offshore wind farms. Under the plan large wind turbines will be erected far away from the coastlines, where the wind blows more consistently than it does on land, and where the enormous turbines won't bother the inhabitants. The plan aims to decrease Germany's dependence on energy derived from coal and nuclear power plants.

Photovoltaic solar power

At the end of 2007 Germany had an installed capacity of 3,830 MWp(megawatts-peak). By the end of 2009, capacity had increased to 9,800 MWp. The first 9 months of 2010 added about 5,400 MWp in new solar capacity. In 2006, the European Commission anticipated that Germany may have installed around 4,500 MWp by 2010. For 2009, the German government calculated that the PV industry provided 64,700 jobs in production, distribution and installation. Over 90 % of solar PV installations are in grid-tied applications in Germany.

Completed in 2006, the 12 MW Solarpark Gut Erlasee photovoltaic system, near Arnstein in Bavaria, was, at the time of construction, the world's largest PV system. The Waldpolenz Solar Park, which is the world’s largest thin-film photovoltaic (PV) power system, became fully operational by the end of 2008. The power plant is a 40 MW solar power system using state-of-the-art thin film technology.

*Geothermal power*

The installed capacity for geothermal energy in Germany was of 8.4 MW in 2007. The total installed capacity of Hydroelectricity in Germany at the end of 2006 was 4.7 GW. Hydropower meets 3.5 % of the electricity demand. Latest estimates show that in Germany in 2007 approx. 9,400 people were employed in the hydropower sector which generated a total turnover of €1.23 billion.

The Internet

The Internet, a global computer network which embraces millions of users all over the world, began in the United States in 1969 as a military experiment. It was designed to survive a nuclear war. Information sent over the Internet takes the shortest path available from one computer to another. Because of this, any two computers on the Internet will be able to stay in touch with each other as long as there is a single route between them. This technology is called packet swithing. Owing to this technology, if some computers on the network are knocked out (by a nuclear explosion, for example), information will just route around them. One such packet-swithing network already survived a war. It was the Iraqi computer network which was not knocked out during the Gulf War.

Most of the Internet host computers (more than 50 %) are in the United States, while the rest are located in more than 100 other countries. Although the number of host computers can be counted fairly accurately, nobody knows exactly how many people use the Internet,

There are millions, and their number is growing by thousands each month worldwide.

The most popular Internet service is e-mail. Most of the people, who have access to the Internet, use the network only for sending and receiving e-mail messages. However, other popular services are available on the Internet: reading USENET News, using the World-Wide Web, telnet, FTP, and Gopher.

In many developing countries the Internet may provide businessmen with a reliable alternative to the expensive and unreliable telecommunications systems of these countries. Commercial users can communicate over the Internet with the rest of the world and can do it very cheaply. When they send e-mail messages, they only have to pay for phone calls to their local service providers, not for calls across their countries or around the world. But who actually pays for sending e-mail messages over the Internet long distances, around the world? The answer is very simple: a user pays his/her service provider a monthly or hourly fee. Part of this fee goes towards its costs to connect to a larg­er service provider. And part of the fee got by the larger provider goes to cover its cost of running a worldwide network of wires and wireless stations.

But saving money is only the first step. If people see that they can make money from the Internet, commercial use of this network will drastically increase. For example, some western architecture compa­nies and garment centers already transmit their basic designs and concepts over the Internet into China, where they are reworked and refined by skilled – but inexpensive – Chinese computer-aided-design specialists.

However, some problems remain. The most important is security. When you send an e-mail message to somebody, this message can travel through many different networks and computers. The data are constantly being directed towards its destination by special computers called routers. Because of this, it is possible to get into any of computers along the route, intercept and even change the data being sent over the Internet. In spite of the fact that there are many strong encoding programs available, nearly all the information being sent over the Internet is transmitted without any form of encoding, i. e. “in the clear”. But when it becomes neces­sary to send important information over the network, these encoding programs may be useful. Some American banks and companies even conduct transactions over the Internet. However, there are still both commercial and technical problems which will take time to be resolved.

An electronic book

An electronic book (e-book, digital book) is a book-length publication in digital form, consisting of text, images, or both, and produced on, published through, and readable on computers or other electronic devices. Sometimes the equivalent of a conventional printed book, e-books can also be born digital. The *Oxford Dictionary of English* defines the e-book as “an electronic version of a printed book,” but e-books can and do exist without any printed equivalent. E-books are usually read on dedicated e-book readers. Personal computers and some mobile phones can also be used to read e-books.

In 1971, Michael S. Hart was given extensive computer time by the operators of the Xerox Sigma V mainframe at the University of Illinois. Seeking a worthy use of this resource, he created the first e-book by typing the United States Declaration of Independence into a computer. *Project Gutenberg* was launched afterwards to create electronic copies of more books.

One early e-book implementation was the desktop prototype for a proposed notebook computer, the *Dynabook,* in the 1970s at PARC (Palo Alto Research Center Incorporated): a general-purpose portable personal computer capable of displaying books for reading.

Early e-books were generally written for specialty areas and a limited audience, meant to be read only by small and devoted interest groups. The scope of the subject matter of these e-books included technical manuals for hardware, manufacturing techniques and other subjects. In the 1990s, the general availability of the Internet made transferring electronic files much easier, including e-books.

Numerous e-book formats, view comparison of e-book formats, emerged and proliferated, some supported by major software companies such as Adobe with its PDF format, and others supported by independent and open-source programmers. Multiple readers followed multiple formats, most of them specializing in only one format, and thereby fragmenting the e-book market even more. Due to exclusiveness and limited readerships of e-books, the fractured market of independents and specialty authors lacked consensus regarding a standard for packaging and selling e-books. In 2010 e-books continued to gain in their own underground markets. Many e-book publishers began distributing books that were in the public domain. At the same time, authors with books that were not accepted by publishers offered their works online so they could be seen by others. Unofficial (and occasionally unauthorized) catalogs of books became available over the web, and sites devoted to e-books began disseminating information about e-books to the public.

U. S. Libraries began providing free e-books to the public in 1998 through their web sites and associated services, although the e-books were primarily scholarly, technical or professional in nature, and could not be downloaded. In 2003, libraries began offering free downloadable popular fiction and non-fiction e-books to the public, launching an e-book lending model that worked much more successfully for public libraries. The number of library e-book distributors and lending models continued to increase over the next few years. In 2010, a Public Library Funding and Technology Access Studyfound that 66 % of public libraries in the U. S. were offering e-books, and a large movement in the library industry began seriously examining the issues related to lending e-books, acknowledging a tipping point of broad e-book usage. However, some publishers and authors have not endorsed the concept of electronic publishing, citing issues with demand, piracy and proprietary devices. Demand-driven acquisition (DDA) has been around for a few years in public libraries, which allows vendors to streamline the acquisition process by offering to match a library’s selection profile to the vendor’s e-book titles. The library’s catalog is then populated with records for all the e-books that match the profile. The decision to purchase the title is left to the patrons, although the library can set purchasing conditions such as a maximum price and purchasing caps so that the dedicated funds are spent according to the library’s budget.

As of 2009, new marketing models for e-books were being developed and dedicated reading hardware was produced. E-books (as opposed to e-book readers) have yet to achieve global distribution. In the United States, as of September 2009, the Amazon Kindle model and Sony's PRS-500 were the dominant e-reading devices. By March 2010, some reported that the Barnes & Noble Nook may be selling more units than the Kindle.

On January 27, 2010 Apple Inc. launched a multi-function device called the iPadand announced agreements with five of the six largest publishers that would allow Apple to distribute e-books. The iPad includes a built-in app for e-books called iBooks and the iBooks Store.

In July 2010, online bookseller Amazon. com reported sales of e-books for its proprietary Kindle outnumbered sales of hardcover books for the first time ever during the second quarter of 2010, saying it sold 140 e-books for every 100 hardcover books, including hardcovers for which there was no digital edition. By January 2011, e-book sales at Amazon had surpassed its paperback sales. In the overall U. S. market, paperback book sales are still much larger than either hardcover or e-book; the American Publishing Association estimated e-books represented 8.5 % of sales as of mid-2010, up from 3 % a year before.

Computers in Our Life

Computers are the future whether we like it or not. Some people dislike computers, because of the complications it takes to understand the basics. Computers are not exactly the easiest tools to work with, but they are the most rewarding, and they are the future.

Future cars will all be run by computer. You will be able to talk to a car and it will take you to your destination. Telephones are technically computerized. You will soon be able to talk to a person on the telephone as well as look at the person you are talking to on a television set. Also television is computerized. Soon we will have true three dimensional television. We will be able to watch television like we never have watched it before. We will be able to touch the characters, and feel the characters like they were in the room with you.

For people who don't know much about computers, you will be lost in the future. You should learn what you can while you still have the chance, because things will develop too quickly for you and you will not be able to cope with new technological events. Computers will fall into careers and our everyday life more rapidly than you think.

Overall, conditions for the majority of jobs dealing mainly with computers, shall include very little manual labor, unfavorable conditions, and much knowledge, typing skills, and good communication skills in dealing with people.

Firstly, computers have, over the years, been taking control of more and more of the dealings of human everyday life, and because of efficiency they have proven, it would be likely to assume that one major change of the computer industry from today until tomorrow will be control of more and more of our everyday life. However, with the computer industry only being around for a short period of time compared to the other industries of the world, we can still get a somewhat accurate idea of where the industry is heading based on the amount of change already incurred by the technology. This along with the job conditions mentioned earlier in this report contributes greatly to a desire of possessing computer knowledge. Names, grades, records – all are accessible by computer.

With computers and the computer industry being the most rapidly changing industry and product in the world, the job outlook for any job dealing with computers or the industry is almost completely unpredictable. Because computers are so rapidly changing not only in their technology but also the amount of job fields they create, earnings is yet another difficult aspect of computers to predict. A computer programmer, one who designs programs (the directions for a computer to follow), usually will work for a company or a large cooperation in designing a program that will be specifically made for that business's applications.

As of now, because computer knowledge is so valuable in today's business world, salaries are quite favorable. To give you an idea of a few of the actual jobs involving computers, and the salaries that they provide, one existing job, and the salary it provides will be discussed in detail. You will use computers to examine and evaluate a patient’s problem quicker and more efficiently. The bottom line is that computers provide worthwhile careers.

Having a job that involves computers, in terms of the conditions, it is very much similar to any office job.

A Brief History of the Microwave Oven

Like many of today's great inventions, the microwave oven was a by-product of another technology. It was during a radar-related research project around 1946 that Dr. Percy Spencer (in the picture), a self-taught engineer with the Raytheon Corporation, noticed something very unusual. He was testing a new vacuum tube called a magnetron, when he discovered that the candy bar in his pocket had melted. This intrigued Dr. Spencer, so he tried another experiment. This time he placed some popcorn kernels near the tube and, perhaps standing a little farther away, he watched with an inventive sparkle in his eye as the popcorn sputtered, cracked and popped all over his lab.

The next morning, Scientist Spencer decided to put the magnetron tube near an egg. Spencer was joined by a curious colleague, and they both watched as the egg began to tremor and quake. The rapid temperature rise within the egg was causing tremendous internal pressure. Evidently the curious colleague moved in for a closer look just as the egg exploded and splattered hot yolk all over his amazed face. The face of Spencer lit up with a logical scientific conclusion: the melted candy bar, the popcorn, and now the exploding egg, were all attributable to exposure to low-density microwave energy. Thus, if an egg can be cooked that quickly, why not other foods? Experimentation began. . .

Dr. Spencer fashioned a metal box with an opening into which he fed microwave power. The energy entering the box was unable to escape, thereby creating a higher density electromagnetic field. When food was placed in the box and microwave energy fed in, the temperature of the food rose very rapidly. Dr. Spencer had invented what was to revolutionize cooking, and form the basis of a multimillion dollar industry, the microwave oven.

In the spring of 1946, Percy Spencer and an associate, P. R. Hanson (Roly Hanson), were working on a secret project they called “the Speedy Weenie”. Muriel Withrow remembers the project well. She recalls, “The ‘Speedy Weenie’ Project was the nickname Mr. Spencer and my boss, Roly Hanson, gave to their secret project, the microwave oven” (‘Speedie Weenie’ meaning ‘a quick hot dog!’).

Engineers went to work on Spencer's hot new idea, developing and refining it for practical use. By late 1946, the Raytheon Company had filed a patent proposing that microwaves be used to cook food. An oven that heated food using microwave energy was then placed in a Boston restaurant for testing. At last, in 1947, the first commercial microwave oven hit the market. These primitive units where gigantic and enormously expensive, standing 5 1/2 feet tall, weighing over 750 pounds, and costing about $5000 each. The magnetron tube had to be water-cooled, so plumbing installations were also required.

Microwave oven

Microwave ovens use microwave energy to heat or cook food in a fraction of the time needed to cook with conventional ovens. Unlike conventional ovens, a microwave oven heats food without applying external heat.

A magnetron tube is used to produce short electromagnetic waves known as microwaves, or R. F. energy. Microwave energy is directed into the cooking chamber where the food is placed to be heated.

The microwaves readily pass through many materials, such as glass, most plastics, paper and china, with little or no effect. Generally, these materials make excellent utensils for cooking in a microwave oven.

Some other materials, such as metal and foil, tend to reflect microwave energy. Except for certain recommended procedures that involve the use of metal or foil as outlined in the use and care manual, use of metal utensils in microwave ovens should be avoided. Why? For the following reasons:

* Metal utensils do not allow complete penetration of the food by the microwaves, so cooking efficiency is greatly reduced.
* If the cooking load is not large enough to absorb the microwave energy, the oven could be damaged by an arc between the metal utensils and the cavity interior or door assembly.
* The life of the magnetron tube can be shortened by extended periods of back-feeding R. F. energy, which raises the magnetron tube's filament temperature.

Because metal reflects microwave energy, the metal walls of the cooking cavity are not affected by microwaves and do not get hot.

Materials with high moisture content, like most foods, absorb microwave energy. As the electromagnetic waves at a frequency of 2450 million cycles per second enter the food, the molecules tend to align themselves with the cycling energy. Since the microwaves are changing polarity with every half cycle, the food molecules follow these alternations and thus move rapidly back and forth. In effect, the food molecules are changing direction every half cycle, so they are oscillating back and forth 4,900,000,000 times each second. This high-speed oscillation causes friction between the molecules, thereby converting the microwave energy to heat.

Microwave Facts and Safety Information

Microwaves are a form of radiant energy. Other common forms are radio waves, visible light, infrared heat and electricity. All forms of radiant energy are a part of the electromagnetic spectrum. To distinguish between the forms, they are classified according to the wave length which may vary from miles to thousandths of an inch.

Microwaves are located in the non-ionizing portion of the energy spectrum between radio waves and visible light. The first application of microwaves was in radar during World War II. Today microwaves are widely used in communication systems, radar and many other commercial and industrial applications.

Significantly large segments of the population are exposed to infrared rays, visible light waves and microwaves every day. One characteristic of microwaves is their ability to bounce or deflect off metal surfaces, a characteristic basic to its use in radar. Another is its thermal or heating effect utilized in microwave cooking.

The difference between microwave energy and other forms of ionizing radiation, such as X-rays, Alpha, Beta and Gamma rays, is that microwave energy is non-ionizing. In other words, it does not alter the molecular structure of the item being heated. The effects of microwave energy are strictly thermal and do not cause cellular change as with ionizing radiation.

No one really knows for sure. Several American laboratories have found that low level exposure to microwaves can cause cumulative effects to the eyes, resulting in cataracts. Research also reports a reduction in personnel efficiency, and even a possible link to cancer. As painstaking experimentation continues, one thing is certain: There is a non-thermal effect from microwaves that many people are exposed to on a daily basis. What degree of danger does this non-thermal effect represent? The answer to that question has to do with the controversial difference between a simple biological effect, and a serious biological hazard. For example, a reduction in the ability to perform certain tasks may be the effect, but at what point does that effect constitute a hazard?

The effects of long term exposure to low levels of microwaves, and their significance to human health, will become clear only after large numbers of people who are being exposed to microwaves are studied for many years. Studies are being done with animals, but it is difficult to translate the effects of microwaves on animals to possible effects on humans. With animals, for example, researchers find it difficult to simulate the conditions under which people use microwave ovens. Because no one can say with certainty what levels of exposure are save, the course of wisdom is, as one U. S. Government spokesman pointed out, to avoid “exposure to any unneeded radiation.”

One pertinent characteristic of microwaves is that they disperse and dissipate very quickly in the atmosphere. Under Federal guidelines set by the Department of Health and Human Services (DHHS), the maximum allowable leakage from a microwave oven [after the sale] is 5 milliwatts [or 5 thousandths of a watt] per square centimeter [or within the area the size of an aspirin tablet], as measured at about 2 inches from the oven surface. However, as you move away from the oven, the level of exposure to any energy that may be leaking decreases dramatically. This may be likened to the difference between holding your hand just inches above a burning candle, and then moving it 10 or 12 inches away.

Fiber-optic communication

Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fiber. The light forms an electromagnetic carrier wave that is modulated to carry information. First developed in the 1970s, fiber-optic communication systems have revolutionized the telecommunications industry and have played a major role in the advent of the Information Age. Because of its advantages over electrical transmission, optical fibers have largely replaced copper wire communications in core networks in the developed world.

The process of communicating using fiber-optics involves the following basic steps: Creating the optical signal involving the use of a transmitter, relaying the signal along the fiber, ensuring that the signal does not become too distorted or weak, receiving the optical signal, and converting it into an electrical signal.

Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Due to much lower attenuation and interference, optical fiber has large advantages over existing copper wire in long-distance and high-demand applications. However, infrastructure development within cities was relatively difficult and time-consuming, and fiber-optic systems were complex and expensive to install and operate. Due to these difficulties, fiber-optic communication systems have primarily been installed in long-distance applications, where they can be used to their full transmission capacity, offsetting the increased cost. Since 2000, the prices for fiber-optic communications have dropped considerably. The price for rolling out fiber to the home has currently become more cost-effective than that of rolling out a copper based network. Prices have dropped to $850 per subscriberin the US and lower in countries like The Netherlands, where digging costs are low.

Since 1990, when optical-amplification systems became commercially available, the telecommunications industry has laid a vast network of intercity and transoceanic fiber communication lines. By 2002, an intercontinental network of 250,000 km of submarine communications cable with a capacity of 2.56 Tb/s (a tebibit per second – a unit of data transfer rate) was completed, and although specific network capacities are privileged information, telecommunications investment reports indicate that network capacity has increased dramatically since 2004.

Transparency and translucency

In the field of [optics](http://en.wikipedia.org/wiki/Optics), transparency (also called pellucidity or diaphaneity) is the [physical property](http://en.wikipedia.org/wiki/Physical_property) of allowing light to pass through a material; translucency (also called translucence or translucidity) only allows light to pass through diffusely. The opposite property is opacity. Transparent materials are clear, while translucent ones cannot be seen through clearly.

When light encounters a material, it can interact with it in several different ways. These interactions depend on the nature of the light (its [wavelength](http://en.wikipedia.org/wiki/Wavelength), [frequency](http://en.wikipedia.org/wiki/Frequency), [energy](http://en.wikipedia.org/wiki/Energy), etc.) and the nature of the material. Light waves interact with an object by some combination of [reflection](http://en.wikipedia.org/wiki/Reflection_%28physics%29), and [transmission](http://en.wikipedia.org/wiki/Transmission) with [refraction](http://en.wikipedia.org/wiki/Refraction).

Some materials, such as [plate glass](http://en.wikipedia.org/wiki/Plate_glass) and clean [water](http://en.wikipedia.org/wiki/Water), allow much of the light that falls on them to be transmitted, with little being reflected; such materials are called optically transparent. Many liquids and aqueous solutions are highly transparent. Absence of structural defects (voids, cracks, etc.) and molecular structure of most liquids are mostly responsible for excellent optical transmission.

Materials which do not allow the transmission of light are called [opaque](http://en.wikipedia.org/wiki/Opacity_%28optics%29). Many such substances have a [chemical composition](http://en.wikipedia.org/wiki/Chemical_composition) which includes what are referred to as [absorption](http://en.wikipedia.org/wiki/Absorption_%28electromagnetic_radiation%29) centers. Many substances are selective in their absorption of [white light](http://en.wikipedia.org/wiki/White_light) [frequencies](http://en.wikipedia.org/wiki/Frequencies). They absorb certain portions of the [visible spectrum](http://en.wikipedia.org/wiki/Visible_spectrum), while reflecting others. The frequencies of the spectrum which are not absorbed are either reflected back or transmitted for our physical observation. This is what gives rise to [color](http://en.wikipedia.org/wiki/Color). The attenuation of light of all frequencies and wavelengths is due to the combined mechanisms of absorption and [scattering](http://en.wikipedia.org/wiki/Light_scattering_in_liquids_and_solids).

How smartphones work

Thinking of a daily task it's likely there's a specialized, pocket-sized device designed to help you accomplish it. You can get a separate, tiny and powerful machine to make phone calls, keep your calendar and address book, entertain you, play your music, give directions, take pictures, check your e-mail, and do countless other things. But how many pockets do you have? Handheld devices become as clunky as a room-sized supercomputer when you have to carry four of them around with you every day.

A smartphone is one device that can take care of all of your handheld computing and communication needs in a single, small package. It's not so much a distinct class of products as it is a different set of standards for cell phones to live up to.

Unlike many traditional cell phones, smartphones allow individual users to install, configure and run applications of their choosing. A smartphone offers the ability to conform the device to your particular way of doing things. Most standard cell-phone software offers only limited choices for re-configuration, forcing you to adapt to the way it's set up.

Yuri Gagarin

The first human spaceflight was [*Vostok 1*](http://en.wikipedia.org/wiki/Vostok_1) (*East 1*), carrying 27 year old Russian [cosmonaut](http://en.wikipedia.org/wiki/Cosmonaut) [Yuri Gagarin](http://en.wikipedia.org/wiki/Yuri_Gagarin) on [April 12](http://en.wikipedia.org/wiki/April_12), [1961](http://en.wikipedia.org/wiki/1961). The spacecraft completed one orbit around the globe, lasting about 1 hour and 48 minutes. Gagarin's flight resonated around the world; it was a demonstration of the advanced [Soviet space program](http://en.wikipedia.org/wiki/Soviet_space_program) and it opened an entirely new era in space exploration – [human spaceflight](http://en.wikipedia.org/wiki/Human_spaceflight).

Yuri Gagarin was born in the village of [Klushino](http://en.wikipedia.org/wiki/Klushino) near [Gzhatsk](http://en.wikipedia.org/wiki/Gagarin%2C_Russia) (now in [Smolensk Oblast](http://en.wikipedia.org/wiki/Smolensk_Oblast), [Russia](http://en.wikipedia.org/wiki/Russia)), on 9 March 1934. The adjacent town of Gzhatsk was renamed Gagarin in 1968 in his honor. His parents, Alexey Ivanovich Gagarin and Anna Timofeyevna Gagarina, worked on a [collective farm](http://en.wikipedia.org/wiki/Collective_farm). Yuri was the third of four children, and his elder sister helped raise him while his parents worked. While a youth, Yuri became interested in space and planets, and began to dream about his space tour which became true one day. Yuri was described by his teachers in the Moscow satellite town of [Lyubertsy](http://en.wikipedia.org/wiki/Lyubertsy) as intelligent and hard-working, if occasionally mischievous. His mathematics and science teacher had flown in the [Soviet Air Forces](http://en.wikipedia.org/wiki/Soviet_Air_Forces) during the war, which presumably made some substantial impression on young Gagarin.

After starting an apprenticeship in a metalworks as a foundryman, Gagarin was selected for further training at a technical high school in [Saratov](http://en.wikipedia.org/wiki/Saratov). While there, he joined the “AeroClub”, and learned to fly a light aircraft, a hobby that would take up an increasing proportion of his time. By dint of effort, rather than brilliance, he reportedly mastered both; in 1955, after completing his technical schooling, he entered military flight training at the [Orenburg](http://en.wikipedia.org/wiki/Orenburg) Pilot's School. While there he met Valentina Goryacheva, whom he married in 1957, after gaining his pilot's wings in a [MiG-15](http://en.wikipedia.org/wiki/MiG-15). Post-graduation, he was assigned to [Luostari](http://en.wikipedia.org/wiki/Luostari) airbase in [Murmansk Oblast](http://en.wikipedia.org/wiki/Murmansk_Oblast), close to the [Norwegian border](http://en.wikipedia.org/wiki/Norway), where terrible weather made flying risky. As a full-grown man, Gagarin was 1.57 metres (5 ft 2 in) tall, which was an advantage in the small [Vostok](http://en.wikipedia.org/wiki/Vostok_spacecraft) [cockpit](http://en.wikipedia.org/wiki/Cockpit). He became [Lieutenant](http://en.wikipedia.org/wiki/Lieutenant) of the [Soviet Air Force](http://en.wikipedia.org/wiki/Soviet_Air_Force) on 5 November 1957 and on 6 November 1959 he received the rank of Senior Lieutenant.

After the flight, Gagarin became a worldwide celebrity, touring widely with appearances in Italy, Great Britain, Germany, Canada, and Japan to promote the Soviet achievement.

In 1962, he began serving as a deputy to the [Supreme Soviet](http://en.wikipedia.org/wiki/Supreme_Soviet). He later returned to [Star City](http://en.wikipedia.org/wiki/Star_City%2C_Moscow), the cosmonaut facility, where he worked on designs for a reusable spacecraft. Gagarin worked on these designs in Star City for 7 years. Gagarin became [Lieutenant Colonel](http://en.wikipedia.org/wiki/Lieutenant_Colonel) (or [Podpolkovnik](http://en.wikipedia.org/wiki/Podpolkovnik)) of the [Soviet Air Force](http://en.wikipedia.org/wiki/Soviet_Air_Force) on 12 June 1962 and on 6 November 1963 he received the rank of [Colonel](http://en.wikipedia.org/wiki/Colonel) ([Polkovnik](http://en.wikipedia.org/wiki/Polkovnik)) of the Soviet Air Force. Soviet officials tried to keep him away from any flights, being worried of losing their hero in an accident. Gagarin was backup pilot for [Vladimir Komarov](http://en.wikipedia.org/wiki/Vladimir_Komarov) in the [Soyuz 1](http://en.wikipedia.org/wiki/Soyuz_1) flight. As Komarov's flight ended in a fatal crash, Gagarin was ultimately banned from training for and participating in further spaceflights.

Gagarin then became deputy training director of the [Star City](http://en.wikipedia.org/wiki/Star_City%2C_Russia) cosmonaut training base. At the same time, he began to re-qualify as a [fighter pilot](http://en.wikipedia.org/wiki/Fighter_pilot). On 27 March 1968, while on a routine training flight out of [Chkalovsky Air Base](http://en.wikipedia.org/wiki/Chkalovsky_Airport), he and flight instructor Vladimir Seryogin (Seregin) died in a [MiG-15UTI](http://en.wikipedia.org/wiki/Mikoyan-Gurevich_MiG-15) crash near the town of [Kirzhach](http://en.wikipedia.org/wiki/Kirzhach). Gagarin and Seryogin were buried in the [walls of the Kremlin](http://en.wikipedia.org/wiki/Kremlin_Wall_Necropolis) on [Red Square](http://en.wikipedia.org/wiki/Red_Square).

Space Tourism

Space tourism is space travel for recreational, leisure or business purposes. A number of [startup companies](http://en.wikipedia.org/wiki/Startup_companies) have sprung up in recent years, hoping to create a [space tourism industry](http://en.wikipedia.org/wiki/List_of_space_tourism_companies). Orbital space tourism opportunities have been limited and expensive, with only the [Russian Space Agency](http://en.wikipedia.org/wiki/Russian_Space_Agency) providing transport to date.

The publicized price for flights brokered by [Space Adventures](http://en.wikipedia.org/wiki/Space_Adventures) to the [International Space Station](http://en.wikipedia.org/wiki/International_Space_Station) aboard a Russian [Soyuz spacecraft](http://en.wikipedia.org/wiki/Soyuz_%28spacecraft%29) have been [US$](http://en.wikipedia.org/wiki/US%24) 20–35 million, during the period 2001–2009. Some of space tourists have signed contracts with third parties to conduct certain research activities while in orbit.

Russia halted orbital space tourism in 2010 due to the increase in the International Space Station crew size, using the seats for expedition crews that would be sold to paying spaceflight participants. However, tourist flights are tentatively planned to resume in 2013, when the number of single-use three-person Soyuz launches could rise to five a year.

List of flown space tourists

Seven of the space tourists flew to and from the [International Space Station](http://en.wikipedia.org/wiki/International_Space_Station) on [Soyuz spacecraft](http://en.wikipedia.org/wiki/Soyuz_spacecraft) through the space tourism company [Space Adventures](http://en.wikipedia.org/wiki/Space_Adventures):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Space tourist** | **Nationality** | **Year** | **Duration of flight** | **Flight** |
| **1.** [Dennis Tito](http://en.wikipedia.org/wiki/Dennis_Tito) | American | 2001 | 8 days (Apr 28 – May 6) | Launch: [Soyuz TM-32](http://en.wikipedia.org/wiki/Soyuz_TM-32)Return: [Soyuz TM-31](http://en.wikipedia.org/wiki/Soyuz_TM-31) |
| **2.** [Mark Shuttleworth](http://en.wikipedia.org/wiki/Mark_Shuttleworth) | South African | 2002 | 11 days (Apr 25 – May 5) | Launch: [Soyuz TM-34](http://en.wikipedia.org/wiki/Soyuz_TM-34)Return: [Soyuz TM-33](http://en.wikipedia.org/wiki/Soyuz_TM-33) |
| **3.** [Gregory Olsen](http://en.wikipedia.org/wiki/Gregory_Olsen) | American | 2005 | 11 days (Oct 1 – Oct 11) | Launch: [Soyuz TMA-7](http://en.wikipedia.org/wiki/Soyuz_TMA-7)Return: [Soyuz TMA-6](http://en.wikipedia.org/wiki/Soyuz_TMA-6) |
| **4.** [Anousheh Ansari](http://en.wikipedia.org/wiki/Anousheh_Ansari) | Iranian/ American | 2006 | 12 days (Sept 18 – Sept 29) | Launch: [Soyuz TMA-9](http://en.wikipedia.org/wiki/Soyuz_TMA-9)Return: [Soyuz TMA-8](http://en.wikipedia.org/wiki/Soyuz_TMA-8) |
| **5.** [Charles Simonyi](http://en.wikipedia.org/wiki/Charles_Simonyi) | Hungarian/ American | 2007 | 15 days (Apr 7 – Apr 21) | Launch: [Soyuz TMA-10](http://en.wikipedia.org/wiki/Soyuz_TMA-10)Return: [Soyuz TMA-9](http://en.wikipedia.org/wiki/Soyuz_TMA-9) |
| 2009 | 14 days (Mar 26 – Apr 8) | Launch: [Soyuz TMA-14](http://en.wikipedia.org/wiki/Soyuz_TMA-14)Return: [Soyuz TMA-13](http://en.wikipedia.org/wiki/Soyuz_TMA-13) |
| **6.** [Richard Garriott](http://en.wikipedia.org/wiki/Richard_Garriott) | American/ British | 2008 | 12 days (Oct 12 – Oct 23) | Launch: [Soyuz TMA-13](http://en.wikipedia.org/wiki/Soyuz_TMA-13)Return: [Soyuz TMA-12](http://en.wikipedia.org/wiki/Soyuz_TMA-12) |
| **7.** [Guy Laliberté](http://en.wikipedia.org/wiki/Guy_Lalibert%C3%A9) | Canadian | 2009 | 11 days (Sept 30 – Oct 11) | Launch: [Soyuz TMA-16](http://en.wikipedia.org/wiki/Soyuz_TMA-16)Return: [Soyuz TMA-14](http://en.wikipedia.org/wiki/Soyuz_TMA-14) |

Subatomic particles

Modern particle physics research is focused on [subatomic particles](http://en.wikipedia.org/wiki/Subatomic_particle), including atomic constituents such as [electrons](http://en.wikipedia.org/wiki/Electron), [protons](http://en.wikipedia.org/wiki/Proton), and [neutrons](http://en.wikipedia.org/wiki/Neutron) (protons and neutrons are composite particles called [baryons](http://en.wikipedia.org/wiki/Baryon), made of [quarks](http://en.wikipedia.org/wiki/Quark)), particles produced by [radioactive](http://en.wikipedia.org/wiki/Radioactive_process) and [scattering](http://en.wikipedia.org/wiki/Scattering) processes, such as [photons](http://en.wikipedia.org/wiki/Photon), [neutrinos](http://en.wikipedia.org/wiki/Neutrino), and [muons](http://en.wikipedia.org/wiki/Muon), as well as a wide range of [exotic particles](http://en.wikipedia.org/wiki/Exotic_particle). To be specific, the term *particle* is a misnomer from classical physics because the dynamics of particle physics are governed by [quantum mechanics](http://en.wikipedia.org/wiki/Quantum_mechanics). As such, they exhibit [wave-particle duality](http://en.wikipedia.org/wiki/Wave-particle_duality), displaying particle-like behavior under certain experimental conditions and [wave](http://en.wikipedia.org/wiki/Wave)-like behavior in others. In more technical terms, they are described by [quantum state](http://en.wikipedia.org/wiki/Quantum_state) vectors in a [Hilbert space](http://en.wikipedia.org/wiki/Hilbert_space), which is also treated in [quantum field theory](http://en.wikipedia.org/wiki/Quantum_field_theory). Following the convention of particle physicists, *elementary particles* refer to objects such as [electrons](http://en.wikipedia.org/wiki/Electron) and [photons](http://en.wikipedia.org/wiki/Photon) as it is well known that these types of particles display wave-like properties as well.

All particles and their interactions observed to date can be described almost entirely by a quantum field theory called the [Standard Model](http://en.wikipedia.org/wiki/Standard_Model). The Standard Model has 17 species of elementary particles: 12 [fermions](http://en.wikipedia.org/wiki/Fermion) or 24 if distinguishing [antiparticles](http://en.wikipedia.org/wiki/Antiparticle), 4[vector bosons](http://en.wikipedia.org/wiki/Vector_boson) (5 with antiparticles), and 1 [scalar boson](http://en.wikipedia.org/wiki/Scalar_boson). These elementary particles can combine to form composite particles, accounting for the hundreds of other species of particles discovered since the 1960s. The Standard Model has been found to agree with almost all the experimental tests conducted to date. However, most particle physicists believe that it is an incomplete description of nature, and that a more fundamental theory awaits discovery. In recent years, measurements of [neutrino](http://en.wikipedia.org/wiki/Neutrino) [mass](http://en.wikipedia.org/wiki/Mass) have provided the first experimental deviations from the Standard Model.

In [physics](http://en.wikipedia.org/wiki/Physics) or [chemistry](http://en.wikipedia.org/wiki/Chemistry), subatomic particles are the smaller particles composing [nucleons](http://en.wikipedia.org/wiki/Nucleon) and [atoms](http://en.wikipedia.org/wiki/Atom). There are two types of subatomic particles: [elementary particles](http://en.wikipedia.org/wiki/Elementary_particle), which are not made of other particles, and [composite particles](http://en.wikipedia.org/wiki/Composite_particle). [Particle physics](http://en.wikipedia.org/wiki/Particle_physics) and [nuclear physics](http://en.wikipedia.org/wiki/Nuclear_physics) study these particles and how they [interact](http://en.wikipedia.org/wiki/Fundamental_interaction).

The elementary particles of the [Standard Model](http://en.wikipedia.org/wiki/Standard_Model) (fig. 2) include:

* six “[flavors](http://en.wikipedia.org/wiki/Flavour_%28particle_physics%29)” of [quarks](http://en.wikipedia.org/wiki/Quark): [up](http://en.wikipedia.org/wiki/Up_quark), [down](http://en.wikipedia.org/wiki/Down_quark), [bottom](http://en.wikipedia.org/wiki/Bottom_quark), [top](http://en.wikipedia.org/wiki/Top_quark), [strange](http://en.wikipedia.org/wiki/Strange_quark), and [charm](http://en.wikipedia.org/wiki/Charm_quark)

* six types of [leptons](http://en.wikipedia.org/wiki/Lepton): [electron](http://en.wikipedia.org/wiki/Electron), [electron neutrino](http://en.wikipedia.org/wiki/Electron_neutrino), [muon](http://en.wikipedia.org/wiki/Muon), [muon neutrino](http://en.wikipedia.org/wiki/Muon_neutrino), [tau](http://en.wikipedia.org/wiki/Tau_%28particle%29), [tau neutrino](http://en.wikipedia.org/wiki/Tau_neutrino)
* thirteen [gauge bosons](http://en.wikipedia.org/wiki/Gauge_boson) (force carriers): the [graviton](http://en.wikipedia.org/wiki/Graviton) of [gravity](http://en.wikipedia.org/wiki/Gravity), the [photon](http://en.wikipedia.org/wiki/Photon) of [electromagnetism](http://en.wikipedia.org/wiki/Electromagnetism), the three [W and Z bosons](http://en.wikipedia.org/wiki/W_and_Z_bosons) of the [weak force](http://en.wikipedia.org/wiki/Weak_interaction), and the eight [gluons](http://en.wikipedia.org/wiki/Gluon) of the [strong force](http://en.wikipedia.org/wiki/Strong_force).

Composite subatomic particles (such as [protons](http://en.wikipedia.org/wiki/Proton) or atomic [nuclei](http://en.wikipedia.org/wiki/Atomic_nucleus)) are [bound states](http://en.wikipedia.org/wiki/Bound_state) of two or more [elementary particles](http://en.wikipedia.org/wiki/Elementary_particle). For example, a proton is made of two [up quarks](http://en.wikipedia.org/wiki/Up_quark) and one [down quark](http://en.wikipedia.org/wiki/Down_quark), while the atomic nucleus of [helium-4](http://en.wikipedia.org/wiki/Helium-4) is composed of two protons and two [neutrons](http://en.wikipedia.org/wiki/Neutron). Composite particles include all [hadrons](http://en.wikipedia.org/wiki/Hadron), a group composed of [baryons](http://en.wikipedia.org/wiki/Baryon) (e. g., protons and neutrons) and [mesons](http://en.wikipedia.org/wiki/Meson) (e. g., [pions](http://en.wikipedia.org/wiki/Pion) and [kaons](http://en.wikipedia.org/wiki/Kaon)).

 Fig. 2. Standard Model of Elementary Particles

Nanotechnology

Nano is used in the metric system to mean 109 or one billionth (1/1,000,000,000). Nanoscience is the study of materials in the nano scale. Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications.

Richard Feynman (in the picture below) was the first to introduce nanotechnology.

Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.

Nano particles and ultrafines have existed since the beginning of time. For example, a cup retrieved from the Roman Empire was found to appear green in regular light, and changed red when illuminated from the inside. This is due to nanosized particles of gold and silver. Researchers consider this to be an accident of the manufacturing process rather than some discovery way ahead of its time.

Nanotechnology involves not just one form of science and/or engineering. Its fields include molecular physics, materials science, chemistry, biology, computer science, bioengineering, computer engineering, electrical engineering, and mechanical engineering.

Nanotechnology is an emerging technology that has a number of potential benefits to many industries (fig. 3) and also a number of potential risks and social implications that are fostering a lot of discussion in many communities around the globe. There are already a number of products on the market that are enhanced by the technology’s potential, and there is a rapidly growing investment in research and development into the process of creating newer products.

Fig. 3. Benefits of nanotechnology to industries

Universal Assemblers

These second-generation nanomachines built of more than just proteins – [will do all that proteins can do, and more](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0023). In particular, some will serve as improved devices for assembling molecular structures. Able to tolerate acid or vacuum, freezing or baking, depending on design, enzyme-like second-generation machines will be able to use as “tools” almost any of the reactive molecules used by chemists – but they will wield them with the precision of programmed machines. They will be able to bond atoms together in virtually any stable pattern, adding a few at a time to the surface of a workpiece until a complex structure is complete. Think of such nanomachines as [assemblers](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0024). Because assemblers will let us place atoms in [almost any reasonable arrangement (as discussed in the Notes](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0025)), they will let us build almost anything that the laws of nature allow to exist. In particular, they will let us build almost anything we can design – including more assemblers. The consequences of this will be profound, because our crude tools have let us explore only a small part of the range of possibilities that natural law permits. Assemblers will open a world of new technologies. Advances in the technologies of medicine, space, computation, and production – and warfare – all depend on our ability to arrange atoms. With assemblers, we will be able to remake our world or destroy it. So at this point it seems wise to step back and look at the prospect as clearly as we can, so we can be sure that assemblers and nanotechnology are not a mere futurological mirage.

Nanocomputers

Assemblers will bring one breakthrough of obvious and basic importance: engineers will use them to shrink the size and cost of computer circuits and speed their operation by enormous factors. With today's bulk technology, engineers make patterns on silicon chips by throwing atoms and photons at them, but the patterns remain flat and molecular-scale flaws are unavoidable. With assemblers, however, engineers will build circuits in three dimensions, and build to atomic precision. The exact limits of electronic technology today remain uncertain because the quantum behavior of electrons in complex networks of tiny structures presents complex problems, some of them resulting directly from the uncertainty principle. Whatever the limits are, though, they will be reached with the help of assemblers. The fastest computers will use electronic effects, but the smallest may not. This may seem odd, yet the essence of computation has nothing to do with electronics. A digital computer is a collection of switches able to turn one another on and off. Its switches start in one pattern (perhaps representing 2 + 2), then switch one another into a new pattern (representing 4), and so on. Such patterns can represent almost anything. Engineers build computers from tiny electrical switches connected by wires simply because mechanical switches connected by rods or strings would be big, slow, unreliable, and expensive, today. The idea of a purely mechanical computer is scarcely new. In England during the mid-1800s, [Charles Babbage invented a mechanical computer built of brass gears](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0030); his co-worker [Augusta Ada, the Countess of Lovelace](http://www.cs.yale.edu/homes/tap/ada-lovelace.html), invented computer programming. Babbage's endless redesigning of the machine, problems with accurate manufacturing, and opposition from budget-watching critics (some doubting the usefulness of computers!), combined to prevent its completion. In this tradition, Danny Hillis and Brian Silverman of the [MIT Artificial Intelligence Laboratory](http://www.ai.mit.edu/) built a special-purpose mechanical computer able to play tic-tac-toe. Yards on a side, full of rotating shafts and movable frames that represent the state of the board and the strategy of the game, it now stands in the [Computer Museum in Boston](http://www.net.org/). It looks much like a large ball-and-stick molecular model, for it is built of Tinkertoys. Brass gears and Tinkertoys make for big, slow computers. With components a few atoms wide, though, a simple mechanical computer would fit within 1/100 of a cubic micron, many billions of times more compact than today's so-called microelectronics. Even with [a billion bytes of storage, a nanomechanical computer could fit in a box a micron wide](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0031), about the size of a bacterium. And it would be fast. Although [mechanical signals](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0032) move about 100,000 times slower than the electrical signals in today's machines, they will need to travel only 1/1,000,000 as far, and thus will face less delay. So a mere mechanical computer will work faster than the electronic whirl-winds of today. Electronic nanocomputers will likely be thousands of times faster than electronic microcomputers – perhaps hundreds of thousands of times faster, if [a scheme proposed by Nobel Prize-winning physicist Richard Feynman](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0033) works out. Increased speed through decreased size is an old story in electronics.

Disassemblers

# Molecular computers will control molecular assemblers, providing the swift flow of instructions needed to direct the placement of vast numbers of atoms. Nanocomputers with molecular memory devices will also store data generated by a process that is the opposite of assembly. Assemblers will help engineers synthesize things; their relatives, [disassemblers](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_Glossary.html#DISASSEMBLER), will help scientists and engineers analyze things. The case for assemblers rests on the ability of enzymes and chemical reactions to form bonds, and of machines to control the process. The case for disassemblers rests on the ability of enzymes and chemical reactions to break bonds, and of machines to control the process. Enzymes, acids, oxidizers, alkali metals, [ions](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_Glossary.html#ION), and reactive groups of atoms called [free radicals](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_Glossary.html#FREE_RADICAL) – all can break bonds and remove groups of atoms. Because nothing is absolutely immune to corrosion, it seems that molecular tools will be able to take anything apart, a few atoms at a time. What is more, a nanomachine could (at need or convenience) apply mechanical force as well, in effect prying groups of atoms free. A nanomachine able to do this, while recording what it removes layer by layer, is [a disassembler](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_References.html#0034). Assemblers, disassemblers, and nanocomputers will work together. For example, a [nanocomputer](file:///D%3A%5CDocuments%20and%20Settings%5C%D0%90%D0%B4%D0%BC%D0%B8%D0%BD%D0%B8%D1%81%D1%82%D1%80%D0%B0%D1%82%D0%BE%D1%80%5CLocal%20Settings%5CTemp%5CRar%24EX71.8516%5CEOC%5CEOC_Glossary.html#NANOCOMPUTER) system will be able to direct the disassembly of an object, record its structure, and then direct the assembly of perfect copies, and this gives some hint of the power of nanotechnology.

What are organic compounds

Organic compounds are the complex compounds of [carbon](http://i.wisegeek.com/what-is-carbon.htm). Because carbon atoms [bond](http://www.wisegeek.com/what-is-a-bond.htm) to one another easily, the basis of most organic compounds is comprised of carbon chains that vary in length and shape. [Hydrogen](http://www.wisegeek.com/what-is-hydrogen.htm), [nitrogen](http://www.wisegeek.com/what-is-nitrogen.htm), and [oxygen](http://www.wisegeek.com/what-is-oxygen.htm) atoms are the most common atoms that are generally attached to the carbon atoms. Each carbon atom has 4 as its valence number which increases the complexity of the compounds that are formed. Since carbon atoms are able to create double and triple bonds with other atoms, it further also raises the likelihood for variation in the molecular make-up of organic compounds.

All living things are composed of intricate systems of inorganic and organic compounds. For example, there are many kinds of organic compounds that are found in nature, such as[hydrocarbons](http://www.wisegeek.com/what-are-hydrocarbons.htm). Hydrocarbons are the molecules that are formed when carbon and hydrogen combine. They are not soluble in water and easily distribute. There are also aldehydes – the molecular association of a double-bonded oxygen molecule and a carbon atom.

There are many classes of organic compounds. Originally, they were believed to come from living organisms only. However, in the mid-1800s, it became clear that they could also be created from simple inorganic proteins. Yet, many of the organic compounds are associated with basic processes of life, such as carbohydrates, proteins, nucleic acids, and [lipids](http://www.wisegeek.com/what-are-lipids.htm).

Carbohydrates are hydrates of carbon and include sugars. They are quite numerous and fill a number of roles for living organisms. For example, carbohydrates are responsible for storing and transporting energy, maintaining the structure of plants and animals, and in helping the functioning of the immune system, blood clotting, and fertilization – to name just a few.

Proteins are a class of organic compounds that are comprised of carbon, hydrogen, nitrogen, and oxygen. Proteins are soluble in water. The protein itself is composed of subunits called [amino acids](http://www.wisegeek.com/what-are-amino-acids.htm). There are 20 different amino acids found in nature – organisms can convert them from one to another for all but eight of the amino acids.

Lipids comprise a class of organic compounds that are insoluble in water or other polar solvents; however, they are soluble in organic solvents. Lipids are made of carbon, hydrogen, oxygen, and a variable of other elements. Lipids store energy, protect internal organs, provide insulation in frigid temperatures, among other features. Lipids can be broken down into several groups ranging from triglycerides, steroids, waxes, and [phospholipids](http://www.wisegeek.com/what-are-phospholipids.htm).

Nucleic acids are another group of organic compounds. They are universal in all living organisms. In fact, they are found in cells and viruses. Some people may not consider a virus to be a living thing. Friedrich Miescher discovered nucleic acids in 1871.

Exit poll

An election exit poll is a poll of voters taken immediately after they have exited the polling stations. Unlike an [opinion poll](http://en.wikipedia.org/wiki/Opinion_poll), which asks whom the voter plans to vote for or some similar formulation, an exit poll asks whom the voter actually voted for. A similar poll conducted before actual voters have voted is called an [entrance poll](http://en.wikipedia.org/wiki/Entrance_poll). Pollsters – usually private companies working for [newspapers](http://en.wikipedia.org/wiki/Newspaper) or broadcasters – conduct exit polls to gain an early indication as to how an election has turned out, as in many elections the actual result may take hours or even days to count.

[Warren Mitofsky](http://en.wikipedia.org/wiki/Warren_Mitofsky), founder of Mitofsky International, is credited with having invented the exit poll.

Exit polls are also used to collect [demographic](http://en.wikipedia.org/wiki/Demographics) data about voters and to find out why they voted as they did. Since actual votes are cast anonymously, polling is the only way of collecting this information.

Exit polls have historically and throughout the world been used as a [check against and rough indicator](http://en.wikipedia.org/wiki/Election_verification_exit_poll) of the degree of [election fraud](http://en.wikipedia.org/wiki/Election_fraud). Some examples of this include the [Venezuelan recall referendum, 2004](http://en.wikipedia.org/wiki/Venezuelan_recall_referendum%2C_2004), and the [Ukrainian presidential election, 2004](http://en.wikipedia.org/wiki/Ukrainian_presidential_election%2C_2004).

Like all opinion polls, exit polls by nature do include a [margin of error](http://en.wikipedia.org/wiki/Margin_of_error). A famous example of exit poll error occurred in the [1992 UK General Election](http://en.wikipedia.org/wiki/United_Kingdom_general_election%2C_1992), when two exit polls predicted a [hung parliament](http://en.wikipedia.org/wiki/Hung_parliament). The actual vote revealed that [Conservative Party](http://en.wikipedia.org/wiki/Conservative_Party_%28UK%29) Government under [John Major](http://en.wikipedia.org/wiki/John_Major) held their position, though with a significantly reduced majority. Investigations into this failure identified a number of causes including differential response rates (the [Shy Tory Factor](http://en.wikipedia.org/wiki/Shy_Tory_Factor)), the use of inadequate demographic data and poor choice of sampling points.