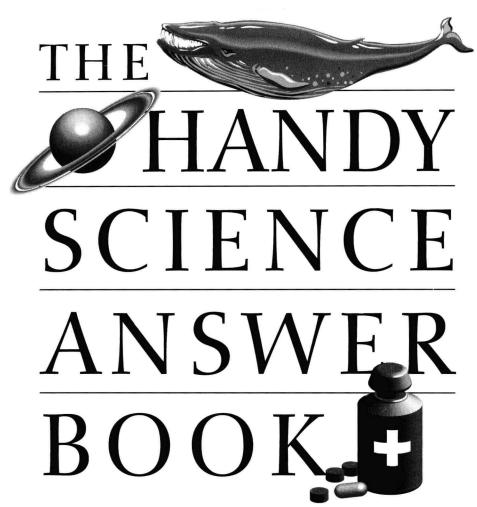


ANSWER BOOKS

Compiled by the Science and Technology Department of the Carnegie Library of Pittsburgh



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DETROIT WASHINGTON D.C. LONDON



THE HANDY SCIENCE ANSWER BOOK

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THE HANDY SCIENCE ANSWER BOOK

Introduction

We live in an age of science and technology, talking on cellular phones, cooking in microwave ovens, and watching our cable television. From the trivial to the complex, gizmos and whatchamacallits dominate modern life. Information whizzes by faster than a speeding bullet. Discoveries are made daily, hourly, by the minute. The horizons of knowledge are becoming mighty distant for many of us. That quizzical staring into space and idle scratching of the head are symptoms of the condition known as *information overload*. Though not life-threatening, it certainly is frustrating.

Wouldn't it be great if someone would just collect the answers to some of the mysteries of daily life? Like, just what is a syzygy? When will the sun die? Why is the sky blue? How deep is the ocean? What are PCBs? What is genetic engineering? When did the Ice Age begin? When did it end? Does rock music kill plants? Why do cats like catnip? How long do specific animals live? What is a male lobster called? Why do people snore? How much blood is in the average human body? How many miles of veins do I have? What is the purpose of goose-bumps? How often does the human eye blink? What is dead reckoning? Why do AM radio stations have a wider broadcast range at night? What is high-definition television? What is a computer "virus" and how is it spread?

The Handy Science Answer Book is just such a collection. Each year, the staff of the Science and Technology Department at The Carnegie Library of Pittsburgh receives nearly 100,000 reference questions and inquiries by the telephone, through the mail, and from personal in-house contact. Even though armed with 390,000 books, 425,000 bound periodicals, and thousands of government documents, technical reports, and microfiche, the Department finds that it requires a special file to answer these questions quickly and reliably. Some of this wealth of cumulative information has been in existence for at least 42 years—as far back as any of the current Carnegie staff can remember. It may even date back to 1905, the year when The Carnegie Library of Pittsburgh became the first major public library in the United States to establish a separate Science and Technology Department. The gems from this ready reference file are shared with you in *The Handy Science Answer Book*.

Handy Science provides answers to more than 1,200 unusual, interesting, or frequently asked questions in the areas of science, pseudo science, and technology. More than

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100 illustrations and many tables augment the text. In some ways, science touches so much of our lives—whether it be our environment, our homes, our workplaces, right down to our physical bodies themselves—that it can become difficult to categorize what actually constitutes science. *Handy Science* makes no particular effort to restrict the questions to pure science, but focuses on those questions that have achieved noteworthiness either through their popularity, the time-consuming nature of their research, or their uniqueness.

The Carnegie staff has verified figures and dates to the best of their ability. Keep in mind that even in science, figures can seem to be in conflict; many times such discrepancies may be attributable to the authority perspective, or more commonly, to the results of simple mathematical rounding of figures. Occasionally, the figure or date listed is a consensus of the consulted sources; other times the discrepancy is noted and alternatives given. *Handy Science* rounds off figures whenever it seems that such precision is unnecessary.

The answers are written in non-technical language and provide either a succinct response or a more elaborate explanation, depending on the nature of the question. Definitions to scientific terminology are given within the answer itself, and both metric and U.S. customary measurements are listed. Following the main Q&A section are suggestions for further reading (most of which were used to answer various questions) and the index.

So, when you're stuck wondering why the clothes you tried on in the store under florescent light look so much different in the light of day, reach for *Handy Science*. Or if you suddenly need to know the lifespan of a chimpanzee (51 years maximum) or the number of horses in the world (65,292,000) or how many muscles it takes to produce a smile (17) or a frown (43), reach for *Handy Science*. You'll find it downright handy.

Acknowledgments

Many people have made significant contributions to *The Handy Science Answer Book* from its initial stage of conception to its realization as a reference work. Margery Peffer kept the work going day after day for almost seven months, as well as answering hundreds of questions, checking leads, verifying sources, assisting other staff members, and generally being one of the finest science reference librarians that I have ever worked with and have known.

The staff librarians in the Science and Technology Department of The Carnegie Library of Pittsburgh know how much I have appreciated both their individual and collective efforts in gathering, reviewing, answering, revising, and verifying many more questions than the number included in this volume. I want to thank Joan Anderson, Naomi Balaban, Jan Comfort, Diane Eldridge, Susan Horvath, Dorothy Melamed, Kristine Mielcarek, David Murdock, Gregory Pomrenke, Gertrude Ross, and Donna Strawbridge for their sustained endeavors. These librarians were remarkable at balancing the never-ending needs of our patrons with the frequent deadlines required for submitting batches of questions. Among those who need to be thanked are Marilyn Macevic, who typed most of the questions in the first draft; Helen Yee, who formatted every question and typed the final copy; Mary Shields, who read and proofed most of the questions, verified citations, and solved numerous problems relating to the citations.

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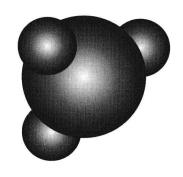
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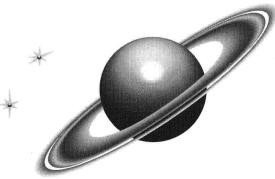
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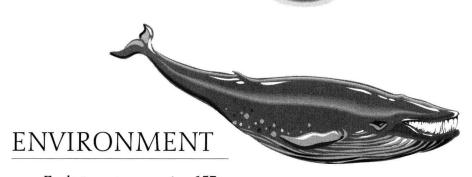
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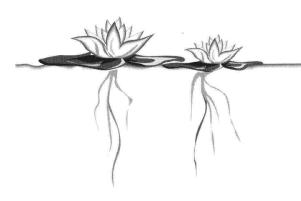
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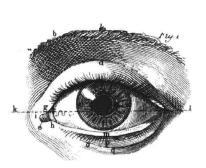
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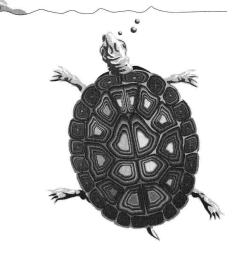
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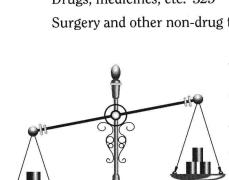
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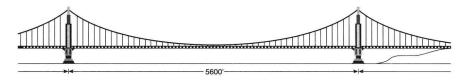
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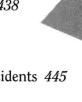
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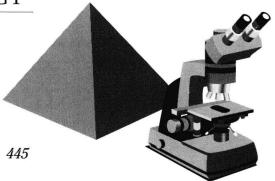
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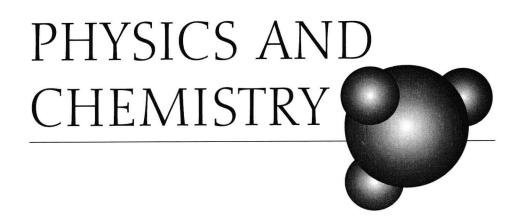
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ENERGY, MOTION, FORCE, AND HEAT

See also: Energy

How is "absolute zero" defined?

Absolute zero is the theoretical temperature at which all substances have zero thermal energy. Originally conceived as the temperature at which an ideal gas at constant pressure would contract to zero volume, absolute zero is of great significance in thermodynamics and is used as the fixed point for absolute temperature scales. Absolute zero is equivalent to 0°K, -459.69°F, or -273.16°C.

The velocity of molecules of substances determines their temperature; the faster they move, the more volume they require, and the higher the temperature becomes. The lowest actual temperature ever reached was two-billionth of a degree above absolute zero (2 x 10-9 Kelvin) by a team at the Low Temperature Laboratory in the Helsinki University of Technology, Finland, in October, 1989.

Does hot water freeze faster than cold?

A bucket of hot water will not freeze faster than a bucket of cold water. However, a bucket of water that has been heated or boiled, then allowed to cool to the same temperature as the bucket of cold water, may freeze faster. Heating or boiling drives out some of the air bubbles in water; because air bubbles cut down thermal conductivity, they can inhibit freezing. For the same reason, previously heated water forms denser ice than unheated water, which is why hot-water pipes tend to burst before cold-water pipes.

What is **superconductivity**?

Superconductivity is a condition occurring in many metals, alloys, etc., usually at low temperatures, involving zero electrical resistance and perfect diamagnetism. In such a material an electric current will persist indefinitely without any driving voltage, and applied magnetic fields are exactly cancelled out by the magnetization they produce. Superconductivity was discovered by Heike Kamerlingh Onnes (1853–1926) in 1911.

What is inertia?

Inertia is a tendency of all objects and matter in the universe to stay still, or if moving, to continue moving in the same direction, unless acted on by some outside force. This forms the first law of motion formulated by Isaac Newton (1642–1727). To move a body at rest, enough external force must be used to overcome the object's inertia; the larger the object is, the more force is required to move it. In his Philosophae Naturalis Principia Mathematica, published in 1687, Newton sets forth all three laws of motion. Newton's second law is that the force to move a body is equal to its mass times its acceleration (F = MA), and the third law states that for every action there is an equal and opposite reaction.

Why do golf balls have dimples?

The dimples minimize the drag (a force that makes a body lose energy as it moves through a fluid), allowing the ball to travel further than a smooth ball would. In a dimpled ball the air, as it passes a ball, tends to cling to the ball longer, reducing the eddies or wake effect that drain the ball's energy. Hit with the same force, the dimpled ball will travel up to 300 yards (275 meters) but the smooth ball only goes 70 yards (65 meters). A ball can have 300 to 500 dimples, each of which can be 0.01 inch (0.25 millimeters) deep. Another effect to get distance is to give the ball a backspin. With a backspin there is less air pressure on the top of the ball, so the ball stays aloft longer (much like an airplane).

Who is the father of the science of **magnetism**?

The English scientist William Gilbert (1544–1603) regarded the Earth as a giant magnet, and investigated its field in magnetism terms of dip and variation. He explored many other magnetic and electrostatic phenomena. The Gilbert (symbol Gb), a unit of magnetism, is named for him.

Why is **Van Vleck** considered to be one of the fathers of modern magnetic theory?

S

Awarded the Nobel Prize in 1977, John H. Van Vleck (1899–1980), an American physicist, made significant contributions in the field of magnetism. He explained the magnetic, electrical, and optical properties of many elements and compounds with the ligand field theory, demonstrated the effect of temperature on paramagnetic materials (called Van Vleck paramagneticism), and developed a theory on the magnetic properties of atoms and their components.

What is **Maxwell's demon**?

An imaginary creature who, by opening and shutting a tiny door between two volumes of gases, could, in principle, concentrate slower molecules in one (making it colder) and faster molecules in the other (making it hotter), thus breaking the second law of thermodynamics. This law states that heat cannot by its own accord flow from a colder to a hotter body. The hypothesis was formulated in 1871 by James C. Maxwell (1831–1879), who is considered to be the greatest theoretical physicist of the 19th century. Maxwell discovered that light consists of electro-magnetic waves, proved the nature of Saturn's rings, set forth the principles of color vision and established the kinetic theory of gases, wherein the nature of heat resides in the motion of the molecules.

When was **spontaneous combustion** first recognized?

Spontaneous combustion is the ignition of materials stored in bulk. This is due to internal heat build-up caused by oxidation (generally a reaction in which electrons are lost, specifically when oxygen is combined with a substance, or when hydrogen is removed from a compound). Because this oxidation heat cannot be dissipated into the surrounding air, the temperature of the material rises until the material reaches its ignition point and bursts into flame.

A Chinese text written before 290 C.E. recognized this phenomenon in a description of the ignition of stored oiled cloth. The first Western recognition of spontaneous combustion was by J.P.F. Duhamel in 1757, when he discussed the gigantic conflagration of a stack of oil-soaked canvas sails drying in the July sun. Before spontaneous combustion was recognized, such events were usually blamed on arsonists.

What is phlogiston?

Phlogiston was a name used in the 18th century to identify a supposed substance given off during the process of combustion. The phlogiston theory was developed in the early 1700s by the German chemist and physicist, Georg Ernst Stahl (1660–1734).