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# Magnetic field current equation

Magnets are used in all kinds of applications, but do you ever wonder exactly why it sticks to certain metals? Find out the answer to this and other questions as we explore exactly how magnets work.By Tracy V. Wilson Electricity and Magnetism dominate much of the world around us – from the most fundamental processes in nature to cutting edge electronic devices. Electric and magnet fields arise from charged particles. Charged particles also feel forces in electric and magnetic fields. Maxwell's equations, in addition to describing this behavior, also describes electromagnetic radiation. In this course, we focus on magnetic fields and forces on charged particles in magnetic fields. We examine different ways of calculating the magnetic field, as well as introducing the ideas of current, resistance and simple direct current (DC) circuits. This is the second module in a series of three that are based on the MIT course: 8.02, Electricity and Magnetism, a required introductory physics class for all MIT undergraduates, which is being offered as an XSeries. Please visit to learn Introductory Electricity and Magnetism XSeries Program Page for more information and to enroll in all three modules. This introductory Electromagnetism physics course will require the use of calculus. What constitutes simple DC circuits How charged particles move in magnetic fields What creates magnetic fields How to calculate magnetic field strength and direction How magnetic dipoles work and how to measure them Receive an instructor-signed certificate with the institution's logo to verify your achievement and increase your job prospectsAdd the certificate to your CV or resume, or post it directly on LinkedInGive yourself an additional incentive to complete the courseedX, a non-profit, relies on verified certificates to help fund free education for everyone globallyUnfortunately, learners residing in one or more of the following countries or regions will not be able to register for this course: Iran, Cuba and the Crimea region of Ukraine. While edX has sought licenses from the U.S. Office of Foreign Assets Control (OFAC) to offer our courses to learners in these countries and regions, the licenses we have received are not broad enough to allow us to offer this course in all locations. edX truly regrets that U.S. sanctions prevent us from offering all of our courses to everyone, no matter where they live. In this section: Cerebral Spinal Fluid (CSF) Shunt Systems July 16, 2019: To increase awareness about programmable CSF shunt valves and magnetic field interference from hearing devices that use magnets, the FDA issued a Letter to Health Care Providers with suggestions for mitigating the risk of unintended valve setting changes. The following strategies may help prevent unintended changes to magnetic externally programmable CSF shunt valves: Ensure Patients and Caregivers Understand the Risks Provide patient education about precautions, including environmental sources of magnetic fields. Inform patients of signs and symptoms that may be associated with valve setting changes. Check Valve Settings Routinely Verify that settings are correct.  Examine patients to ensure that they are not experiencing over- or underdrainage of CSF. Report Problems As the primary users of CSF Shunts, clinicians play a critical role in conducting safety checks, assessing the performance of these devices, and reporting issues that impact their performance. Prompt reporting of adverse events can help the FDA identify and better understand the risks associated with medical devices. Additional data are needed to understand fully the possible relationship between magnetic externally programmable CSF shunt valves and magnets found in the environment. However, it is reasonable to assume that a shunt valve that is manipulated by a hand-held magnetic tool may also be vulnerable to other external magnetic sources. Report all details surrounding unintended valve-setting change events including, but not limited to: Details of the resetting event, including the suspected distance of the shunt from the magnetic source Identify the suspected magnetic source(s) Severity of patient symptoms Change in valve setting value from intended setting Manufacturer and brand of magnetically programmable shunt Patient age, gender, underlying diagnosis for shunt (such as trauma, hydrocephalus) Other medical devices in region of shunt (for example, cranial plate, cochlear implant Device evaluation post-explant, if available Be aware that adverse event reports can still be submitted to the FDA under the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule. Back to Top This site is not available in your country Scientists have designed a hydrogel loaded with magnetic particles and laboratory-grown neurons. By applying magnetic force, the researchers were able to reduce the pain signaling of the neurons.Share on PinterestWhen applied to neurons, a magnetic field can reduce the cells' pain signals, suggests a new study. In the United States, chronic pain is "the most common cause of long-term disability."According to the National Institutes of Health (NIH), over 76 million people in the U.S. — that is, approximately 1 in 4 people — have had an episode of pain that lasted for more than 24 hours.Of these, 40 million have had severe pain. Such figures led the NIH to deem chronic pain "a major public health problem."In this context, the search for new, more effective pain management therapies is ongoing and of vital importance. Now, bioengineers from the University of California, Los Angeles (UCLA) have designed an innovative method that may succeed where other pain therapies have previously failed.Researchers led by senior investigator Dino Di Carlo, a professor of bioengineering at UCLA, set out to investigate how magnetic force could be used to relieve pain.The first author of the paper is Andy Kah Ping Tay, a postdoctoral researcher at Stanford University in California. The researchers published their findings in the journal Advanced Materials.Tay and his colleagues designed a hydrogel using hyaluronic acid, which is a molecule uniquely capable of retaining water and that has key roles in skin moisture and skin aging. Additionally, hyaluronic acid can be found between the cells in the brain and in the spinal cord.After creating this hyaluronic hydrogel, the scientists filled it with small magnetic particles. Then, they grew a type of brain cell — called dorsal root ganglion neurons — inside the gel.Next, Tay and team applied magnetic force on the particles, which enabled the transmission of the magnetic field through the hydrogel and to the neural cells. By measuring the calcium ions in the neurons, the scientists were able to tell whether the cells responded to the magnetic pull — and they did.Finally, the researchers steadily increased the magnetic force and found that doing so reduced the neurons' pain signaling. In an attempt to return to a stable state, the brain cells adapted to the magnetic stimulation by decreasing their pain signals."Our results show that through exploiting 'neural network homeostasis,' which is the idea of returning a biological system to a stable state, it is possible to lessen the signals of pain through the nervous system […] Ultimately, this could lead to new ways to provide therapeutic pain relief."Andy Kah Ping TayProf. Di Carlo also comments on the results, saying, "Much of mainstream modern medicine centers on using pharmaceuticals to make chemical or molecular changes inside the body to treat disease.""However," he adds, "recent breakthroughs in the control of forces at small scales have opened up a new treatment idea — using physical force to kick-start helpful changes inside cells. There's a long way to go, but this early work shows this path toward so-called 'mechanoceuticals' is a promising one." Many animals can detect changes in the earth's magnetic field, and they use this sense to navigate. A recent study finds that humans may also have this ability.Share on PinterestMany animals can detect magnetic fields, but can we?We have evolved to detect a range of sensory inputs, including light, sound, and odors.Other members of the animal kingdom have developed sensitivities that seem to lie beyond our capabilities.Many species, including certain bacteria, birds, molluscs, and marine mammals, demonstrate magnetoreception — meaning that they can detect fluctuations in magnetic fields.They use this ability to orient themselves in the environment and to navigate.In the 1980s, there was a flurry of research investigating whether humans could detect these subtle shifts, but the results were contradictory and proved difficult to replicate.The debate quietened down. Recently, however, scientists at the California Institute of Technology in Pasadena and the University of Tokyo in Japan decided that the time was right to revisit magnetoreception in humans.In the 40 years that followed the initial burst of interest in human magnetoreception, scientists have developed a far more detailed picture of how the sense works in animals.Scientists have learned that some animals use a twopronged approach to navigate using magnetic fields: a compass and a map response. The compass response simply uses the field to orient the animal relative to the local north/south direction.The magnetic map is more detailed; it uses field intensity and direction to build a picture of where the animal is relative to where it wants to go.It seems clear that if we can detect magnetic fields, we are not conscious of it. The authors of the recent study believe that this is the primary reason that earlier studies have failed — they were looking for behavioral responses to something that humans probably detect subconsciously.Over recent decades, brain scan technology has come on leaps and bounds. It is now possible to measure brain activity far more precisely than ever before.So, rather than looking for behavioral responses, the scientists decided to measure responses in the brain directly. They published their intriguing findings in the journal eNeuro earlier this week.The researchers used EEG scanning technology to investigate brain activity. At the same time, they manipulated the magnetic field within an isolated, radiofrequency-shielded chamber. They paid particular attention to the participants' alpha rhythm. Explaining why, they say:"The alpha rhythm is the dominant human brain oscillation in the resting state when a person is not processing any specific stimulus or performing any specific task […]. When an external stimulus is suddenly introduced and processed by the brain, the alpha rhythm generally decreases in amplitude."Scientists call this measurable change in activity "alpha event-related desynchronization." As they expected, they found that in some participants, there was a decrease in alpha event-related desynchronization when the magnetic field changed.However, the magnitude of the response varied greatly between participants.In the second set of experiments, the researchers focused on the participants with the most robust responses to changes in magnetic field.By examining these people, they could confirm that their responses were tuned to the magnetic field of the Northern Hemisphere, where the study took place. The authors conclude:"Our results indicate that human brains are indeed collecting and selectively processing directional input from magnetic field receptors."This has been a hot topic in the scientific community for decades. Therefore, it will take more than one study to prove definitively that humans can detect changes in the earth's magnetic field.However, if scientists do finally prove that humans can detect magnetic fields, would it be such a shock? As the authors write:"Given the known presence of highly evolved geomagnetic navigation systems in species across the animal kingdom, it is perhaps not surprising that we might retain at least some functioning neural components, especially given the nomadic hunter/gatherer lifestyle of our not-too-distant ancestors.""The full extent of this inheritance remains to be discovered." 1 From Cannabis Slang to Celebration: The History of 420 2 Civil Rights Leaders You Won't Read About in History Books 3 How Many Times Has Donnie Swaggart Gotten Divorced? 4 What Is Mass Marketing? Advantages & Disadvantages 5 What Type of Oil Does a Dodge Ram 1500 Use? How Was Magnetic Energy Discovered? Magnetic energy was first discovered by Scottish physicist James Clerk Maxwell, when he was studying the nature of magnetism and electricity. What he discovered was the opposite of what was thought at the time — that magnetism and electricity were completely unrelated. Instead, he discovered that electrical current was associated with magnetic fields and that the reverse was also true: that magnetic fields had an electrical current. This was not only the discovery of magnetic energy but the precursor to the study of electromagnetic energy. What Is a Magnet? A magnet is any type of material from which a magnetic field is produced. A magnet has two poles, called the North Pole and South Pole. At each end is where the magnetic energy is the strongest. However, these are indeed polar opposites. You can only connect magnets via opposite poles. For example, you can connect a north pole to a south pole, or a south pole to a north pole, but if you try to connect two north poles or two south poles, the magnets will repel each other. This is magnetic energy similarly as when to two magnets attract. Also, you cannot break a magnet in half to make the poles connect. The South Pole and North Pole, with respect to each one's magnetic field, are immovable.  What Are Some Uses of Magnets? Everyone is certainly familiar with magnets that hang on the refrigerator or as part of children's toys, such as when two wooden trains connect with magnets. However, magnets have many other uses out in the world. Magnets help electric generators to run. Imagine when your power goes out and your need a generator — what do you think causes these free-standing units to run? Magnets inside the generator near coils cause electricity, which runs the generator. Also, magnets run wind turbines. The wind powers the turbine, but what the wind does is spin the magnet to power the turbine. Magnetic fields can also create electric current to run over the top of a wire.  What Types of Magnets Are There? There are three types of magnets that exist: permanent magnets, temporary magnets, and electromagnets. Electromagnets have the more complex science of the three, and are used to power televisions, computers, motors, and other electronic equipment.  What Are Permanent and Temporary Magnets? Permanent and temporary magnets are the most common types of magnets you'd come in contact with in everyday life, particularly permanent magnets. A permanent magnet is any type of magnet that never loses its magnetic energy. That means that, once it is magnetized, it will always be magnetized. Even if it loses some magnetism over time, such as using a refrigerator magnet year after year, it is still magnetized. A temporary magnet is much different and is often the subject of science fair experiments. A temporary magnet is very easily magnetized by some type of outside force but loses its magnetism quickly. For example, if you take a paper clip to a strong magnet, that paper clip will become a magnet itself easily for a few seconds. This is also known as a "soft" magnet.