National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Assessment Resource

Science Level 1

Resource title: Are Biomags Dangerous?

This exemplar supports assessment against:

Achievement Standard 90941

Investigate the Implication of Electricity and Magnetism in Everyday Life

Expected responses
The moderators have developed expected student response from a wide variety of sources.

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To support internal assessment from 2011

Resources used: www.magnetictherapyfacts.org
www.newscientist.com
www.magneticbracelet.co.uk
www.skepdic.com/magnetic.html
http://news.bbc.co.uk/2/hi/health/4101045.stm
http://www.quackwatch.com/04ConsumerEducation/QA/magnet.html

A variety of sources should be used so that the information is not seen to be biased. This is the text basis of the presentation the student might produce.

Viewpoint chosen: magnetic bracelets do/do not alleviate arthritis

Grade: Excellence

Some well-known studies have been carried out on selected sections of the community to see if any health benefits could be recorded. It important to remember when looking at research that the studies are often funded by organisations that have an interest in the outcome, often this is financial i.e. the makers of magnetic bracelets would like a positive outcome to see their sales increase.

A double blind study at The Baylor College of Medicine in Houston study compared the effects of magnets and devises without magnets on knee pain. 50 adult patients with pain from having polio when they were young were tested. A static magnetic device was put on the patient's skin for a short time and they were asked to rate how much pain they experienced when a point on their body was pressed. The 29 patients given the magnetic device achieved lower pain scores than the rest who were not given the magnets. The results were not seen as reliable because there were more women in the experiment group and they are influenced more by the placebo effect and there was a difference in age between the two groups. It was only a short exposure to the magnet and the amount of pressure applied to the patients before and after the treatment to measure the pain felt was not measured and checked to be even to ensure it was a fair test.

Researchers at the New York College of Podiatric Medicine have tested patients in a 4-week period, 19 patients wore a molded insole containing a magnetic foil and 15 patients who wore a fake insole. Both sets of patients showed a 60% reported improvement showing that the magnets made no difference to the patient. Caselli of the New York College of Podiatric Medicine in the US, who has carried out work on the possible use of magnets to treat heal pain says," this is not conclusive proof that people should run out and buy magnet, but you shouldn't discount them entirely – there may be a future use for them."

At the Mayo Clinic they did the same experiment as the New York College over an 8-week period by 101 people with heel pain and found no difference between the treatment and control groups Mark Winemillar of the county Mayo Clinic in Rochester, Minnesota, said, "Without a plausible, or even proposed, mechanism, it's difficult for me to accept results as valid, "he says. "The placebo effect is much more likely than any actual effect"

A study led by Tim Harlow of the College of Cullompton, Devon in UK studied 200 people aged 45 to 80 with osteoarthritis were given magnetic bracelets and non magnetic control group, after 12 weeks all 3 groups reported less pain, the magnetised bracelets report less pain than the control group but there was no statistical difference in the magnetic groups, this would be expected if the bracelets actually had a physical effect. Dr Harlow and his team were funded by *the Arthritis Research Campaign as they wanted to find out if magnetic bracelets worked and makes sure people were not wasting their money. They said: "We cannot be certain whether our data show a specific effect of magnets, a placebo effect, or both. Results appear to show that wearing a magnetic bracelet does reduce pain in people with hip and knee osteoarthritis although it is still unclear whether this effect is due in some part to the placebo effect."*

Some of the people most impressed with magnet therapy are professional athletes, however it is always wise to bare in mind that they are being paid to say that a particular product is effective. Their beliefs are based on little scientific testing so the is the case with many manufacturers of magnetic products.

The necessary next step in further research on this subject would be more wide ranging and larger scale trials than those conducted so far. They have been too small to have a significant statistical basis for their findings. With the current level of scientific knowledge and research available it can be seen that there is not scientific basis for the belief that magnetic bracelets can reduce pain. There is also a lack of credible research to support the claims that manufacturers are making about what their products can do. Manufacturers can advertise their products with many claims about the potential benefits of magnetic therapy without the scientific evidence to back it up, they use much anecdotal evidence from users and as discussed here the benefits patients experience are mainly from a placebo effect.

Grade: Merit

Unipolar magnets have just one pole of the magnet at each side of the magnet; bi-polar magnets have two poles at the same time on one side of the magnet. Both types are used in magnetic therapy. The Gauss rating of a magnet is the unit of measurement relating to magnetic strength 10,000 Gauss = 1 Tesla, (the SI unit) the Gauss scale is still used in medicine as the strength of the magnets is small, it shows the density of magnetic field lines.

The magnet physical size is related to strength of magnet and the penetration ability into the body. The manufacturers rating are the grade of magnetic material. The surface rating is the gauss rating and represents the magnetic flux density generated outside the magnet so tells you what will penetrate the skin. Usually use 6 lots 800 gauss magnets are used to treat injury. 2000/3000 gauss magnets are recommended for serious or long time chronic problems. If magnets are covered by glass, plastic or thick clothes, it slows the absorption rate of the magnetic field, taking several hours, the magnetic field begins to dissipate so it is much weaker when it reaches the body. Magnets with a large surface area produce a larger magnetic field but the ones with a higher gauss value will penetrate deeper into the tissue.

Inflammation occurs when an injury happens to allow more blood carrying important substances such as white blood cells to aid healing, this increase in fluid in the cells can cause damage called an oedema. This can lead to arthritis if it is untreated and become chronic. Static magnet can reduced the inflammation and start repairing the cells. When magnetic fields are present in the blood, toxins in the tissues, caused by white blood cells consuming bacteria are drawn out and carried to the liver for detoxification and excretion by the kidneys. Magnet can only reduce the inflammation when they are near to the source of the pain, when they are removed the inflammation may return. They are not a treatment for the disease process, the time over which the pain will return depend on the person and the injury. Results may be seen anywhere between 2 day and 6 weeks depending on the person and injury history. They can also help heal nervous tissue and bones by speeding migration of calcium ions.

Both poles have beneficial properties, the south pole is calming, soothing and reducing and the north pole is stimulating, healing and growth properties. Some people say you can only use one pole at a time and must rest for 2-3 weeks before changing as some people experience side effects from one pole, other say using bipolar devises is best. You can't use these if you are receiving chemotherapy as you don't want to promote cell growth.

World Health Organisation said in a 1987 study that magnetic strengths used are not detrimental. They advise that pregnant women and those with medical devices such as pacemakers shouldn't use magnets. Small children should be kept away from magnets and they should not be used near fresh cuts or wounds.

Bio magnetic therapy is generally regarded as safe, and some people prefer a non drugs approach that does not have the side effects. Some patients like to be in control of the therapy, it is portable and can go with you and they are convenient. These can be an advantage.

However, Magnetic therapy is called a pseudoscience as there is no established effect on health or healing. "I know of no scientist who takes this claim seriously...It's another fad. They come and go like copper bracelets and crystals and all of these things, and this one will pass too." --Robert Park of the American Physical Society.

Haemoglobin is the blood protein that carries oxygen and it is weakly diamagnetic and repulsed by magnetic fields, but the magnets used in magnetic therapy are many time too weak and falls away too quickly to have an effect on the blood flow. A study of static field strengths up to 1000 Gauss showed no effect on blood flow or tissue oxygenation and people using MRI scanner with a 15,000 Gauss rating did not report any of the effects people using magnetic bracelets did. There is also the worry that the idea of magnetic therapy can lead people into delaying an appropriate medical diagnosis

*There is no scientific evidence that magnets do anything to the blood. Stephen Barrett, M.D. says that "magnets have also been claimed to increase circulation. This claim is false. If it were true, placing a magnet on the skin would make the area under the magnet become red, which it does not. Moreover, a well-designed study that actually measured blood flow has found no increase." The study involved 12 healthy volunteers who were exposed to either a 1000-gauss magnetic disk or an identically appearing disk that was not magnetic. A study of static field strengths up to 1Tesla showed no effect on blood flow or tissue oxygenation. "Iron atoms in a magnet are crammed together in a solid state about one atom apart from one another. In your blood only four iron atoms are allocated to each hemoglobin molecule, and they are separated by distances too great to form a magnet. This is easily tested by pricking your finger and placing a drop of your blood next to a magnet. " --Michael Shermer*****

Some supporters of magnetic therapy also believe that all illness is due to some sort of imbalance in energy in the body. The balance or flow of electromagnetic energy must be restored for good health and they think magnets can help with this. The flow of ions that the magnets are said to cause it so some that the energy change would be lost when the patient made a slight movement such as twitching a finger.

There is no scientific basis to conclude that magnetic bracelets that contain static magnets can relieve pain, change the make up of your blood or cure any diseases. The effects reported by some pain sufferers have not been demonstrated in trials and pain relief evidence has not been found, the only exception being with some people suffering osteoarthritis. At present, there is no basis to believe that static magnets have any more healing power than many other objects. As the National Centre for Complementary and Alternative Medicine states: "Overall, the research findings so far do not firmly support claims that magnets are effective for treatment of pain."

Unbiased studies are a problem as magnetisation can be easily detected by the attractive forces so the blind testing can be difficult. Usually you would want the doctor and patient to not know who has the placebo; this is called a double blind experiment. Detecting the magnetism can make the patient more susceptible to the placebo effect, especially when the effects are small.

Grade: Achieved

Magnets are any objects which have their own magnetic field. These can be permanent or created from electricity, an electromagnet. Magnets have a North and South Pole and the field lines showing the magnetic field run from North to South. Like poles, north and north, repel each other whilst unlike poles north and south, attract each other. The earth has its own magnetic field and acts like a very large bar magnet with a north and South Pole. The earth's magnetic field is lees than 1 gauss in strength, which is very small. We are exposed to magnetic fields everywhere in our everyday life. Machines such as MRI scanners are around 15,000 gauss, whilst the largest magnets on earth are 300,000 Gauss.

There are different types of magnets, ferrite and neodymium. Ferrite are made of iron and barium and hold their strength for many years, don't get effected by temperature, relatively low cost, can be fragile but can be mixed with rubber to be pliable. Neodymium magnets have that element added as well and are 10 times stronger for their size but can't be made very big. They are lightweight and can be very small for their magnetic strength; they corrode easily and must be coated. They can demagnetise at high temps and last for about 10 years.

A minimum value of 800 gauss is needed to penetrate the skin. The strength decreases as you get further away from a magnet using the inverse square law so 4cm away it is only $1/16^{th}$ of the strength at the surface.

There is some scientific theory quoted about the way magnetic therapy works in the body.

People believe that magnets affect the blood mechanism within the tissue, so it can improve circulation and help to transport nutrients and toxins around the body more effectively. It can also help to transport endorphins to help with pain relief. All cells in the body contain ions, which are positively and negatively charged, they conduct electrical pulses and allow the cells to function. In healthy cells positive ions are on one side of the membrane and they line up with negative ions on the other side as opposite poles attract, this allows fluid and nutrients to move freely. In diseased cells they are distributed unevenly and this may lead to too much fluid entering the cell so nutrients are pushed out, these cells will degenerate and die. Placing a magnet with the correct polarity and intensity over the affected areas penetrates the tissue and the magnetic field around the outside of the cell pulls the ions back into line and the damage is repaired over a few days.

The effects that people report are often explained by the placebo effect; this means when people are given medication or a devise which actually does nothing medically but they believe that it does and report feeling the positive effects of the treatment. The effect can be seen even when the patient is told that their treatment is the one that have no active ingredient.