

2021 DESIGN & TECHNOLOGY WEEK CHALLENGE

"Developing Creative Problem Solvers"

MOVE IT!

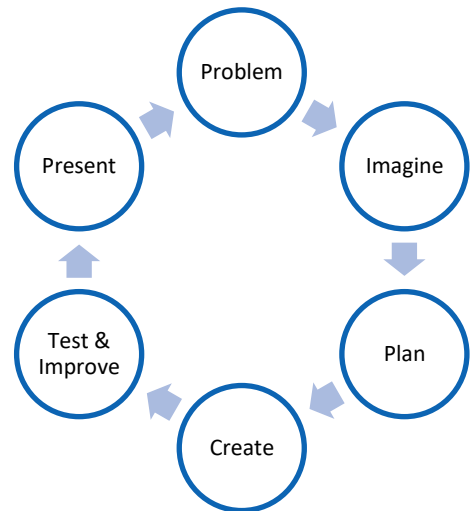
Structures of all sizes surround us – whether natural or man-made. Structures are elements that are combined to support a load in a stable manner. All structures have four basic functions. These are: to **support**, to **contain**, to **protect** and to **span**.

There are three types of structures. They are often combined.

Shell - solid outside but hollow inside

Frame - a combination of parts that work together increase strength of individual parts

Mass - structure has only one solid part



THE FUNDAMENTALS

Design should take into consideration things such as: outside forces (e.g. weather), looks, suitable materials, construction, strong base, safety, environment and cost.

THE CHALLENGE

The Problem:

Design and build a device that can lift a magnet into the air, pick up magnetic objects and then move them to a different area. The more magnetic objects it can lift and the further it travels the better!

Consider:

- What devices are used to lift objects? Move objects?
- Are there any **simple machines** that would solve the problem? Simple machines are: the lever, the wheel and axle, the inclined plane, the wedge, the pulley, and the screw.
- The size, shape and strength of your magnet.
- What magnetic items would allow you to pick up the MOST pieces at one time?
- Which type of magnet would be the best match?

The Solution:

- What do you need?
- How did you make the device?
- Testing and improving
- Record how your device worked. Did it work you had planned? Did you need to make changes to your plans? Would you do anything differently?
- How many magnetic items could you pick up at one time?

**I THINK.
I QUESTION.
I DESIGN.
I CREATE.
I STRUGGLE.
I COLLABORATE.
I TRY.
I SOLVE.
I INVENT.
I REFLECT.
I LEARN.**

INVESTIGATE MAGNETS AND MAGNETISM







TYPES OF MAGNETS

There are four types of magnets

1. **Natural magnet** – found naturally in the ground
2. **Temporary magnet** – last only a short time, weak
3. **Permanent magnet**- man made from hard iron, holds its magnetism
4. **Electromagnet** – Needs an electric current to work. Electromagnets are created by running an electrical current through a coil with a metal core. The energized coil creates a magnetic field. When the current is shut off, the magnetic field disappears.

MAIN SHAPES OF PERMANENT MAGNETS

There is a North and South poles on each of these magnets. You may like to investigate the Magnetic fields on the different magnets.

Bar magnet	Horseshoe magnet	U-shaped magnet
		
Ring Magnet	Disc magnet	Cylindrical magnet
		

KEY WORDS

Attract

Repel

Magnet

Magnetise

Poles

North

South

Field

Magnetism

Temporary

Permanent

Electromagnet

Magnetic Object

Magnetic Field

Temporary Magnet

Repulsion

FACTS ABOUT MAGNETS



Magnets are solid objects of stone, metal, or other material.	Magnets attract iron-containing materials.	Magnets have two poles – north and south. Opposite poles attract (pull together) while similar poles repel (push apart).
If you cut a magnet in half you will always have two poles.	Two magnets together are stronger than one magnet but two magnets will not be twice as strong as one.	As more magnets are stacked together, the strength will increase until the length of the stack is equal to the diameter.
The magnetic field generated by any magnet is always strongest at either pole. Both are equal in strength.	A magnet is destroyed by hammering or heating. This is because the molecules lose their north-south alignment and get arranged in random directions.	The Earth's magnetic field is 1,000 times weaker than a typical bar magnet.
The most powerful magnet in the universe is type of star called a magnetar .	Earth, Saturn, Jupiter, Neptune, and Uranus are the only planets in our solar system with magnetic fields.	Magnets have been used for centuries for navigation.
A compass shows earth's magnetic north and south magnetic poles.	Magnets can be found in many common household items such as telephones, computers, stereos, refrigerators, washing machines, lamps, and TV's.	Fridge magnets have flexible rubber or ferrite magnet on the back. They can hold lightweight items.
Powerful electromagnets are used in high-speed trains, called Maglev trains. These trains will float over its track, reducing friction and allowing the train to run very efficiently.	Magnetic resonance imaging (MRI) machines use magnets and computer-generated radio waves to create detailed images of the organs and tissues in your body	Some animals can sense magnetic fields e.g. bees, sharks, birds and turtles.
Magnets can damage magnets inside electronic devices.	Not all metals are attracted to magnets. Sometimes only parts of an object are magnetic.	Metals such as iron, nickel and steel are attracted to magnets

ELECTROMAGNETISM

Electromagnets are not permanent magnets. As soon as electricity is turned off the magnet no longer works.

Why use an electromagnet? These magnets can be very strong and lift huge loads, make lifting safer for people and objects can be moved higher. They are used on machines such as forklifts, pallet handlers, cranes and hoists.

Industries that use electromagnets include:

- **Construction** – lifting timber, cement and equipment
- **Mining** – lift earth, rock ore and equipment
- **Shipping** - overhead cranes to lift heavy objects.
- **Manufacturing and Warehouses** – lift pallets and heavy items and move to another area faster.
- **Transportation** – moving heavy loads onto trucks etc.
- **Recycling** – move scrap materials



A crane with an electromagnet lifting scrap metal waste.

<https://www.serpent-dove.com.au>



A steel-pipe-lifting-magnet.

<https://copperalliance.eu>

REFERENCES

<https://www.apexmagnets.com/news-how-tos/8-strange-facts-about-magnets-and-magnetism/>

<https://www.education.com/science-fair/article/two-magnets-twice-strong/>

<https://www.entrepreneurshipinbox.com/23964/what-are-industrial-lifting-magnets-used-for/>

Magnetic Resonance Imaging

MRI - DO NOT ENTER

Magnetic resonance imaging (MRI) machines use magnets and computer-generated radio waves to create detailed images of the organs and tissues in your body.

Patients lie very still in the machine while the magnet spins around them at huge speed.

The following symbols are from a safety poster from a MAGNATOM. The MRI's magnets will attract all these things so must not be taken into a room with the machine.

The Problem:

Design a poster using your own choice of symbols to warn of danger.

- Choose a safety topic or improve the Magnetom poster.
- Keep the poster simple and easy to read.



Magnetic field	Implants susceptible to electromagnetic effects, e.g. cardiac pacemakers, defibrillators, hearing aids, insulin pumps, medication pumps.	Mechanical watches, electrical data carriers, such as pocket calculators, digital clocks, etc.	Data carriers, such as credit cards and identity cards with magnetic strips, magnetic tapes.
Metal parts and medical instruments of all types.	Implants made of metal and other metal objects in the body such as splinters.	Open fire	Fire extinguishers with magnetisable metal housing.