Engineering

Pathfinder honour

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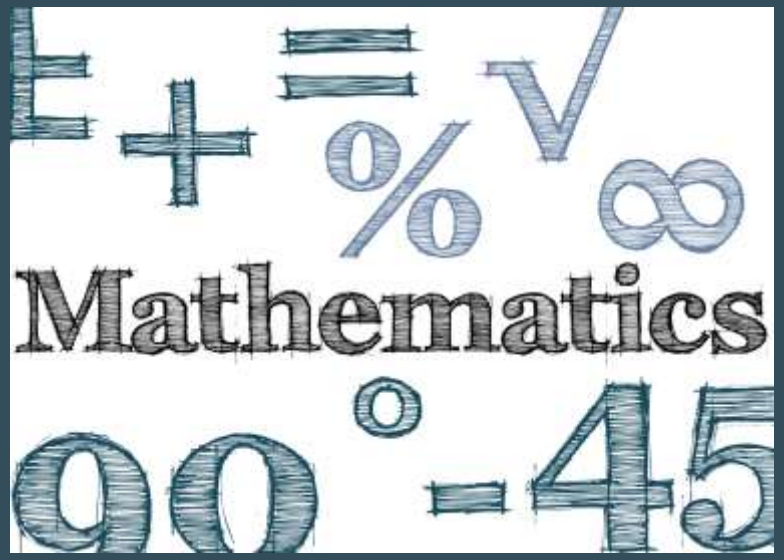
SEC Area Co-ordinator

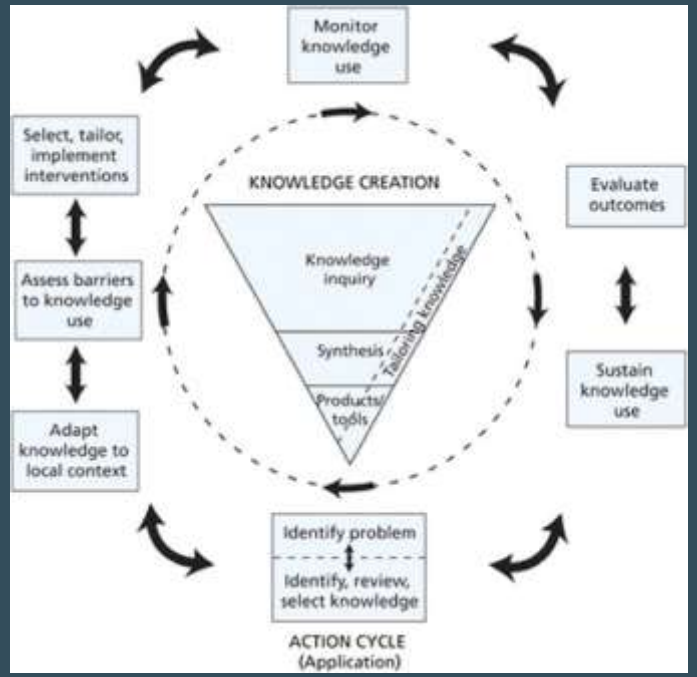
Requirements

1. What is Engineering?
2. Define the following four branches of engineering:- Chemical, Electrical, civil and mechanical
3. Identify and define at least 15 additional disciplines of engineering
4. Explain the general responsibilities of an engineer
5. Discuss what type of education is required for a career in engineering
6. How has the discipline of engineering contributed to society?
7. On your own or with a group, develop a chart board that outlines a brief history of a famous engineer, highlighting their contributions to society. Prepare and give an oral presentation on your findings
8. Read Genesis 6, discuss the biblical context of this chapter drawing comparisons to the field of engineering
9. Identify four specific biblical engineering marvels that illustrate the art and importance of engineering
10. Define the following terms as it relates to the engineers discipline. CAD, simulation, rendering, steady state, constraint.
11. What is reverse engineering?
12. Give a real world example where reverse engineering is useful
13. On your own or with a group, complete one of the following engineering projects, OR a project at your skill level. Build a paper plane trimming and making adjustments for better flight. Build a compass using a box, a nail and a magnet. Build a miniature dam using popsicle sticks and rocks

Engineering
what do you know?

ECONOMICS is the study of how people choose to use their scarce resources in an attempt to satisfy their unlimited wants.





1. Engineering is.....

- The study and practical application of science, economics, maths and practical knowledge to solve the issues of society

2. Define the following 4 branches of engineering

Chemical engineering

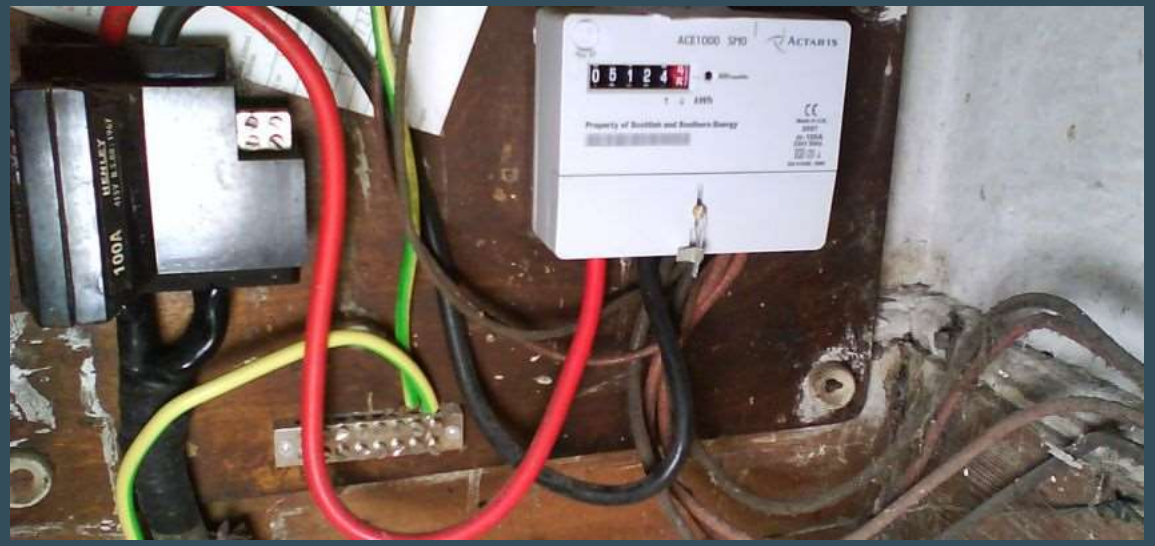
Focuses on processes from applied sciences (chemistry, physics, biology, microbiology and biochemistry) that convert raw materials of chemicals into more useful forms

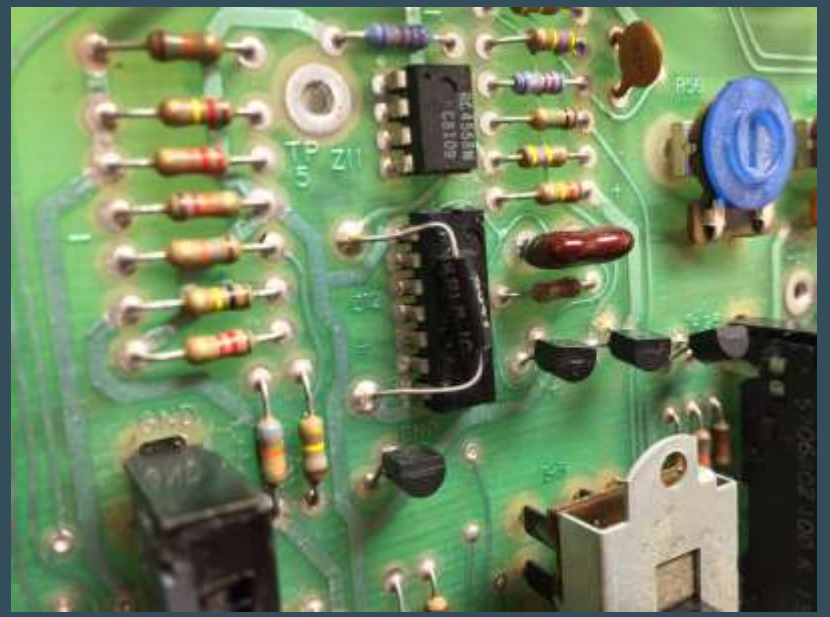
Chemical engineers create and manufacture materials and products we use every day. These include plastics, pharmaceuticals, personal care products, petrochemicals, agrochemicals, biomaterials and cement.

Biochemical engineering is the use of biological (natural or organic) materials, such as organisms, cells and certain molecules, to develop products and processes. Industries that depend on biochemical engineering include biotechnology, biofuels, pharmaceuticals, water purification and food. They use biochemical engineering to research, develop and produce materials and products that will benefit society or human well-being. The resulting products are often made of a combination of organic and laboratory-produced materials.

Electrical engineering

- Focuses on the study of electricity, electronics, and electromagnetism and its uses related to designing, testing and manufacturing electrical equipment.
- These include transformers, **electric** generators, **electric** motors, high voltage **engineering**, and power electronics.





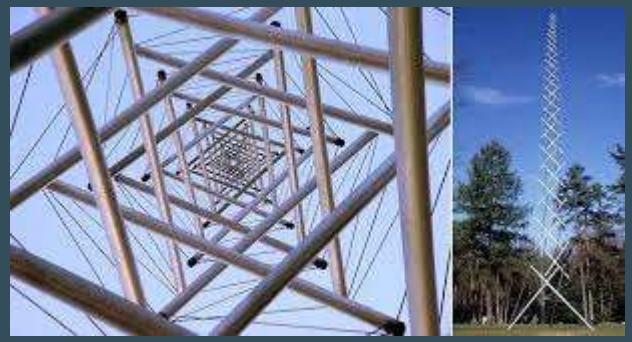
What is the role of an electrical engineer?

Electrical engineering
is the design, building and maintenance of **electrical** control systems, machinery and equipment. ... **Electrical engineers** work in transport networks, lighting, heating, ventilation, lift systems, power generation and distribution, renewable energy, manufacturing and construction

Civil engineering

- **Focuses on sciences that involve the design, construction and maintenance of structures such as bridges, buildings and tunnels. It also includes roads and underground utilities like water, sanitary sewer, storm sewer and natural gas etc.**
- The five types of civil engineering projects are **construction** and **management**, **geotechnical**, structural, transport, water, and architecture. Each of these projects requires extensive knowledge of math, mechanics, and physics as well as the ability to solve problems creatively.





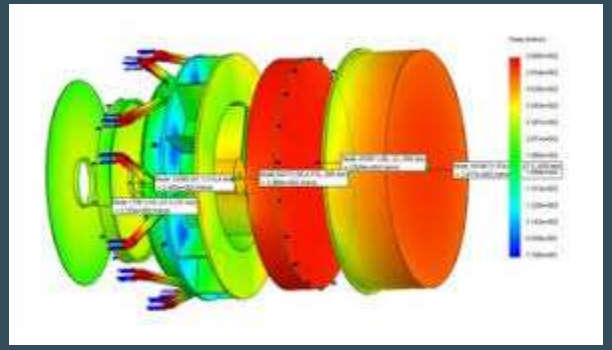

What is the role of the civil engineer?

- **Civil engineers**
- design major transportation projects. **Civil engineers** conceive, design, build, supervise, operate, construct and maintain infrastructure projects and systems in the public and private sector, including roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment.

Mechanical engineering

- **Examples** of products that **mechanical engineers** can design and develop are: transmissions; engine parts; aircraft engines; control systems; prosthetic devices; disk drives; printers; semiconductor tools; sensors; gas turbines; wind turbines; fuel cells; compressors; robots; and machine tools.

Mechanical engineering is one of the broadest **engineering** disciplines. **Mechanical engineers** design, develop, build, and test. They deal with anything that moves, from components to machines to the human body.



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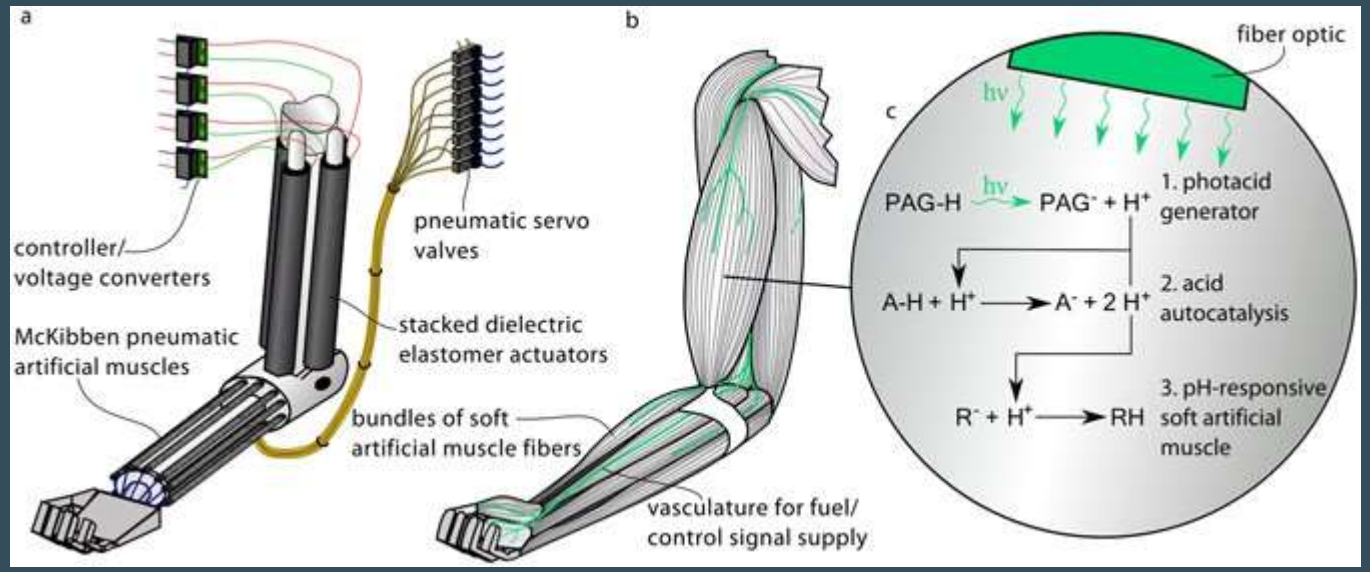


Prosthetic engineering

Involves the design and fitting of mechanical or robotic limbs to human beings

What is the role of a mechanical engineer?

- On a **daily basis**, **Mechanical Engineers** confer with **engineers** or other personnel to implement operating procedures, resolve system malfunctions, or provide technical information. They perform personnel functions, such as supervision of production workers, technicians, technologists, or other **engineers**.

Mechanical engineers design power-producing machines, such as electric generators, internal combustion engines, and steam and gas turbines, as well as power-using machines, such as refrigeration and air-conditioning systems. **Mechanical engineers** design other machines inside buildings, such as elevators and escalators.

- **Mechanical engineering can be classified into many profiles and these are also the career options for Mechanical engineers.**
- Procurement **engineer**.
- Sales **Engineer**.
- Application **engineer**.
- Marketing **engineer**.
- Purchase **engineer**.
- Design **engineer**.
- Logistics and supply chain management.
- And more.

A **sales engineer** is thus both "a salesperson that understands and can apply **engineering**" and "an **engineer** that understands how to sell engineered systems". They not only sell but also provide advice and support.

Working as a bridge between customers and **engineering** teams, **Application Engineers** use customer input and sales information to design or re-design, develop, test and implement complex software programs and **applications**.

Marketing engineers are an essential part of a company's **marketing** team because they apply technical knowledge to sales and **marketing** campaigns. They help internal sales teams and external clients understand the technical aspects of a product. ... However, they may also travel to meet with clients as needed.

Procurement Engineers oversee the purchasing of technical goods and services for an industrial operation. **Procurement Engineers** have very detailed knowledge of the equipment, materials and supplies used in a particular industry, and are able to identify companies that sell them.

3. Identify and define at least 15 additional disciplines of engineering

https://en.wikipedia.org/wiki/List_of_engineering_branches

Can you name some of the types of engineering genres? What are the different ways in which engineering is used throughout the field?

Aerospace

Optical

Computer

Industrial

Traffic

Process engineering

Nuclear

Materials

Geotechnical

Environmental

Energy engineering

Structural

Power engineering

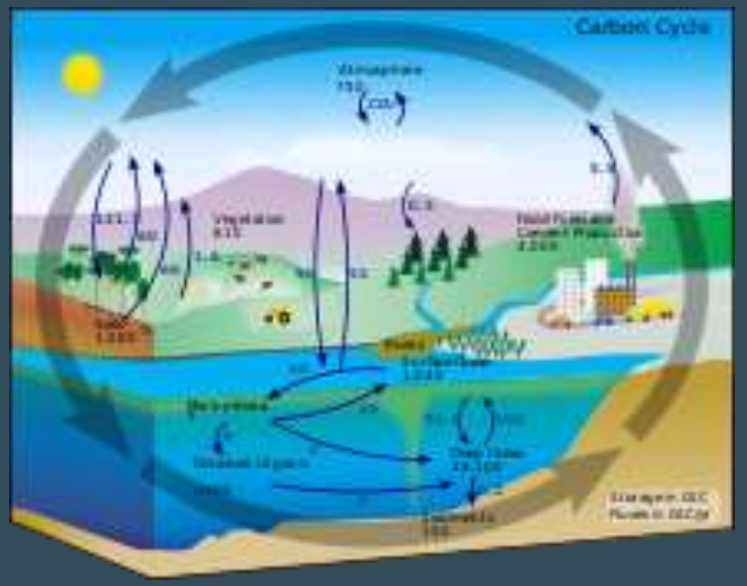
Acoustical

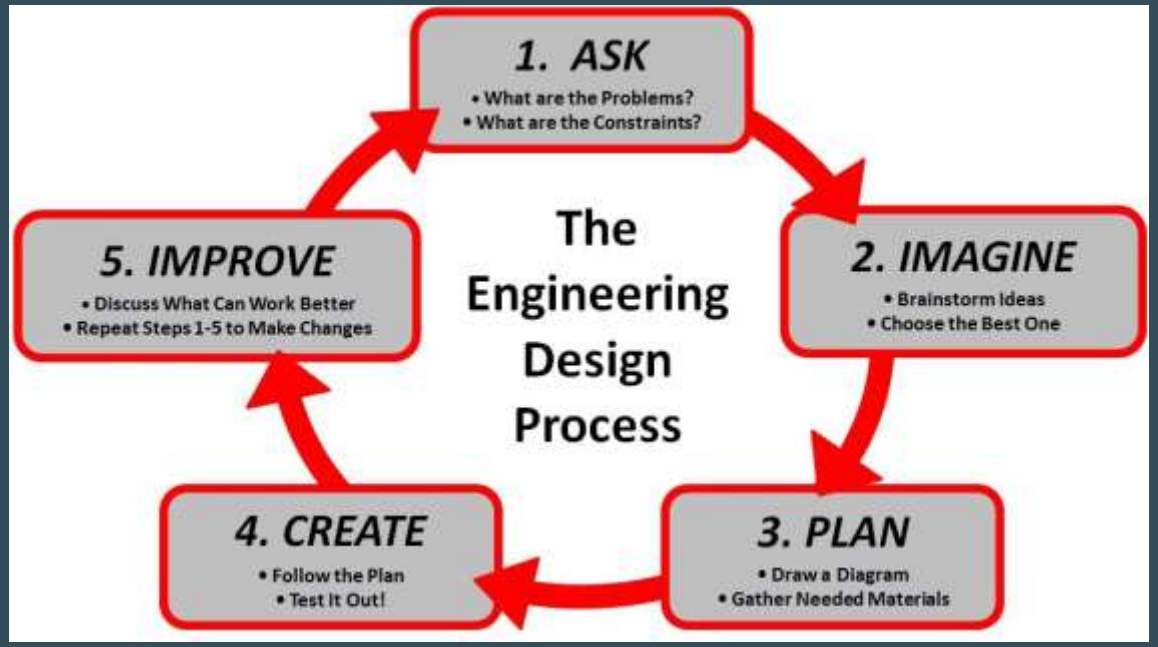
Transport

Biological

Textile


AEROSPACE ENGINEERING
Because they ain't gonna create themselves

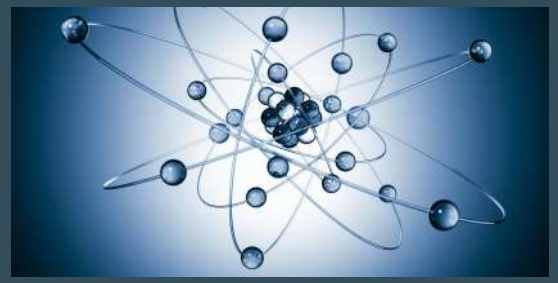

Carbon Cycle


1. ASK
• What are the Problems?
• What are the Constraints?
2. IMAGINE
• Brainstorm Ideas
• Choose the Best One
3. PLAN
• Draw a Diagram
• Gather Needed Materials
4. CREATE
• Follow the Plan
• Test It Out!
5. IMPROVE
• Discuss What Can Work Better
• Repeat Steps 1-5 to Make Changes
The Engineering Design Process

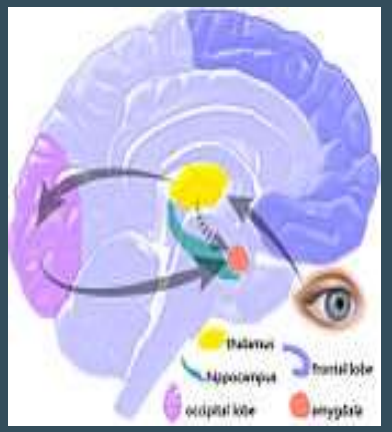
4. Explain the general responsibilities of an engineer

- An engineer is a highly regarded professional that focuses on solving problems of society on a larger scale through design and analysis. This is primarily accomplished by applying their in depth knowledge of the sciences, mathematics, as well as their gift of critical thinking into practical use for the benefits of society.
- Engineers are often tasked with developing ways to accomplish similar task, but with more cost effective approaches, stronger and lighter materials, and streamlined and updated resources.

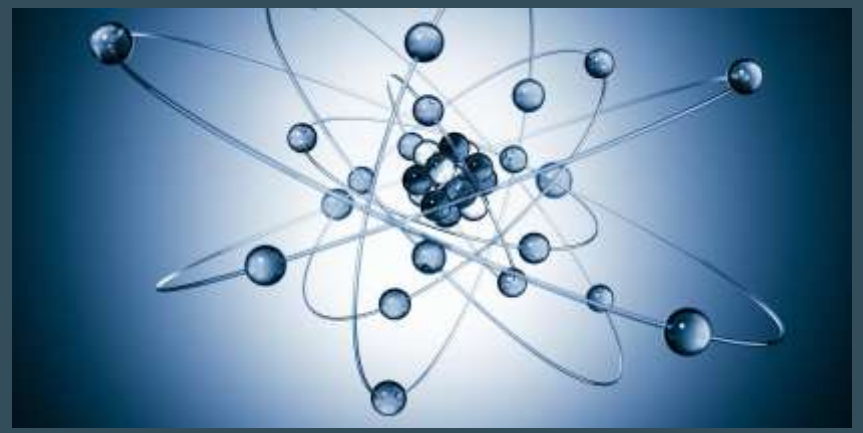
5. Discuss what type of education is required for a career in engineering



What qualifications would you need to be an engineer?
Would it depend on the branch of engineering?



At a minimum, an undergraduate degree is required in order to begin a successful path as an engineer in any field. Due to the number of engineering fields, each discipline focuses on specific coursework. As such, a strong science oriented and mathematical background is required. This may include substantial coursework in biology, physics, advanced math, life sciences, or chemistry just to name a few.



6. How has the discipline of engineering contributed to society?

Bridges

Transport

Aerospace


virgin america
Virgin
UNITED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Food and nutrition

The development and manufacture of foods


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Special Issue
Food Bioactives: From evidence of health benefits to understanding mechanisms
Guest Editors
Paul Finglas and Paul Kroon
TRENDS IN
FOOD SCIENCE
& TECHNOLOGY


Product Development
Food Safety & Packaging
Sensory Evaluation
Nutrition
Sustainability
Food Science

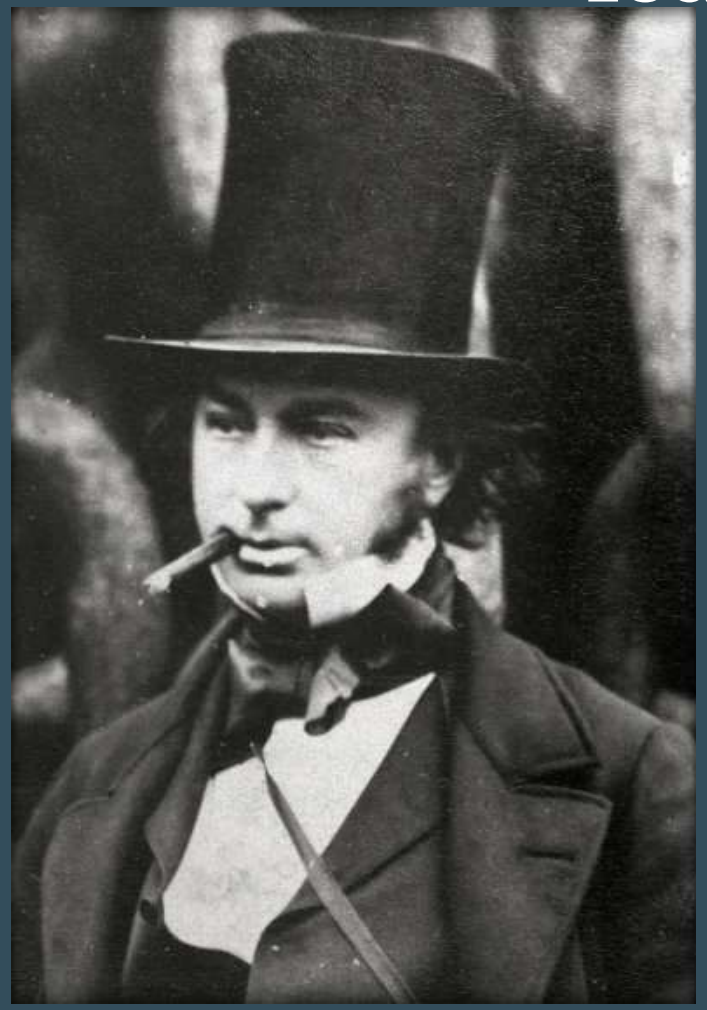
7. On your own or with a group, develop a chart board that outlines a brief history of a famous engineer, highlighting their contribution to society. Prepare and give an oral presentation of your findings

Consider the type of engineering that this person has developed.

Dates, places, times, etc.

What about famous women engineers?

Isambard Kingdom Brunel



1.Isambard Kingdom Brunel was born on 9 April 1806 in Portsmouth.
2.Brunel's parents sent him to the finest schools in England and France to learn the skills he needed to be an engineer.
3.Brunel worked on the Thames tunnel with his dad, who was also an engineer. He almost drowned when the roof collapsed and flooded in 1827!
4.While Brunel was recovering, he entered and won a competition to design a bridge over the Avon river gorge in Clifton, Bristol – this later became the **Clifton Suspension Bridge.**
5.He married Mary Horsley in 1836. They had three children: Isambard Junior, Henry Marc and Florence Mary. Henry also became an engineer when he grew up.
6.Brunel was known for wearing a tall black top hat – very stylish in Victorian times!
7.Brunel was the chief engineer of the Great Western railway, and **he designed the railway line between London and Bristol. He also designed the Temple Meads station in Bristol, and Paddington station in London**.
8.Brunel also designed fast **ships** – the SS Great Western, the SS Great Britain and the SS Great Eastern.
9.Brunel died on 5 September 1859. He is buried at Kensal Green cemetery in London.
10.Brunel's legacy has lasted long after 1859. His constructions are still used today!

8. Genesis 6 – read and discuss the biblical perspective with regard to engineering

The dimensions are quite specific. Since a cubit was roughly 18 inches, the ark would have been about 450 feet long, 75 feet wide, and 45 feet high. (For comparison, the length and width of the QE2 is 963 feet and 105 feet respectively.) The bottom of the ark would have been flat. There is neither a power source nor a rudder. The only plan for this ark was that it would float wherever God intended it to go. There is nothing to suggest that either Noah or his sons would have been expected to navigate this vessel.

9. Identify 4 specific biblical engineering marvels that illustrate the art and importance of engineering

10. Define the following terms as it relates to the engineering discipline

CAD

Computer Aided Design

is a 2 D and 3 D special computer type software that offers powerful designing capability. It is regularly used by engineers, architects, designers, inventors and mechanics

Simulation

is a technique that allows engineers to justify selected equipment necessary to address projects in their early stages of development. Equipment such as software, computers, and machinery can simulate a designed process, thus allowing engineers to select the best solutions to their issues

Rendering

is the ability to render 2D or 3D scenes from CAD designs. A type of software with rendering ability allows engineers and designers to quickly develop 3D scenes using this method.

Steady state

is a term that can have multiple meanings depending on the engineering discipline in question

Electrical engineering

the ability for a machine powered by electricity to regain its original powered state.

Mechanical engineering

the ability to regain stability after a force is applied

Constraint

is a term used to describe preset limitations. They can be based on any combination of the following:- cost, safety concerns, reliability, environmental impact, or any concern that can impact on the completion of a project according to predetermined standards. An engineering constraint might be that a bridge has to support a fully loaded truck, or the building must withstand a 7.0 earthquake to be approved by the city

11. What is reverse engineering?

Reverse engineering is the process of learning software or how a machine functions without prior documentation. Documentation can then be developed based on what has been learned as resources continue to focus on figuring out its functionality

Reverse engineering, also called back **engineering**, is the process by which a man-made object is deconstructed to reveal its designs, architecture, code or to extract knowledge from the object; similar to scientific research, the only difference being that scientific research is about a natural phenomenon.

> Reverse engineering may be required when a component or its spare parts are no longer available, or the component is failing or not functioning properly and the original manufacturer cannot provide the necessary engineering support to correct the problems. The goal in such cases is to generate the necessary technical information to support, replace, or improve the component.

This process has three main stages:

- **Implementation** recovery. Quickly learn about the application and prepare an initial model.

- Design recovery. Undo the mechanics of the database structure and resolve foreign key references.

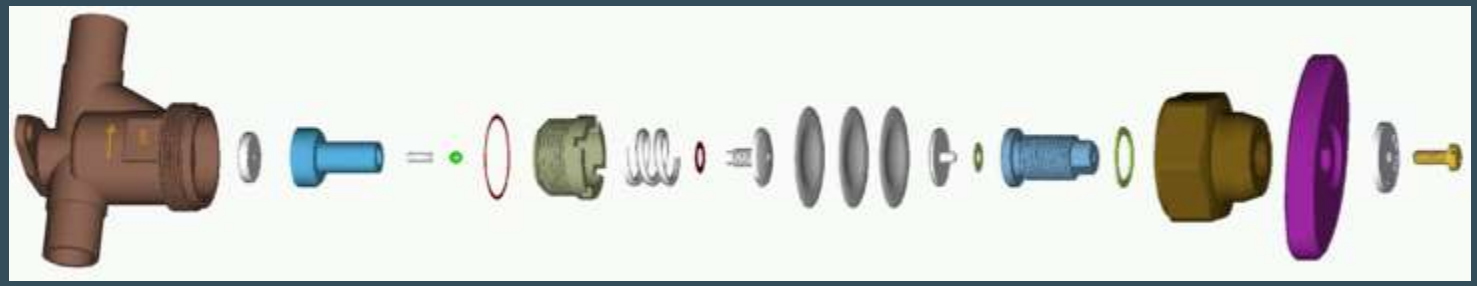
- **Analysis** recovery. Remove design artifacts and eliminate any errors in the model.

Examples of LCE reverse engineered components include:

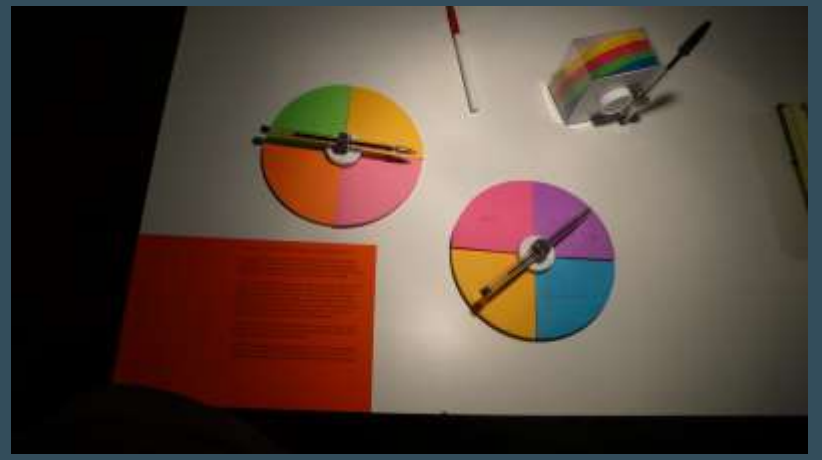
•Fire-fighting sprinkler valves
•Air-conditioning and refrigeration system packed and packless valves (see below)
•Mechanical seals
•Air conditioning system dryer housing assembly
•High temperature bolt/washer assembly
•Bleed-air valve components

AC System Valve

The application was a 7/8 inch AC system valve on U.S. Navy ship for which there was no OEM spare part or maintenance support, no similar commercial valves available, and no drawings available. The technicians reverse engineered the 21 individual parts not available off-the-shelf, including determination of dimensions, tolerances, material specifications, heat treatments and surface coatings, and prepared detailed drawings suitable for competitive bid and procurement.



The fun bit



Please remember to submit your oral and practical work to your assessor

We would like to see your photos of any of the practical challenges

send them to dejan@adventist.uk