Engineering Disciplines

Engineering

Engineering is the application of mathematics and scientific principles to better or improve life.

PLTW | Engineering

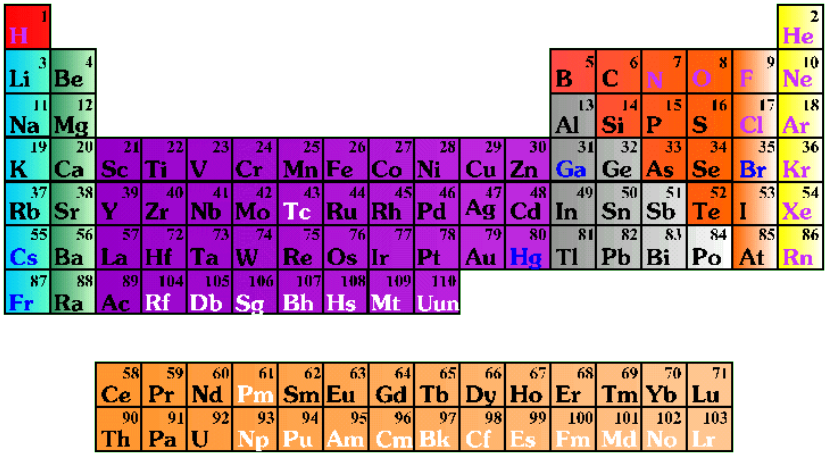
Fields of Engineering (Disciplines)

- The **big four** fields of engineering include:
  - Chemical
  - Civil
  - Electrical
  - Mechanical
- Most other disciplines are a derivative, combination, or extension of one of these.

PLTW | Engineering

Chemical Engineering

- Uses chemistry to convert chemicals, raw materials, living cells, microorganisms and energy into useful forms and products.
  - Uses matter (solids, liquids, and gas)
  - Uses elements in the periodic table
- Responsible for new and improved products and processes:
  - Fuels,
  - Teflon, Nylon
  - Medicines, vaccines, penicillin
  - Plastics, synthetics and textiles
  - Steel, aluminum, LCD screens
  - Batteries, lithium ion batteries
  - Soda , Silly putty
  - Ebola and zika vaccines,
  - Cure for cancers
  - Cleaner fuel sources
  - 3D printing of food
  - Hyperloop

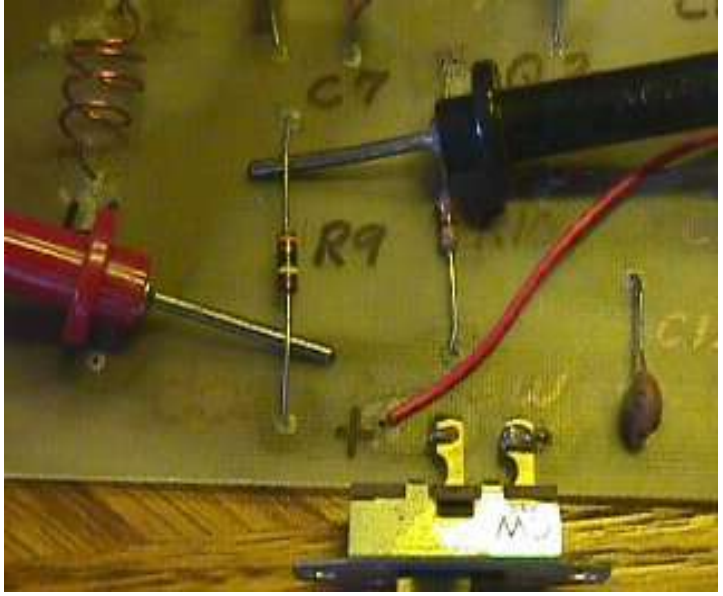


Civil Engineering

- discipline that deals with the design, construction, and maintenance of the physical man made and naturally built environment
  - Roads
  - Bridges
  - Canals
  - Dams,
  - Airport and Launch Facilities
  - Offshore structures
  - Buildings
  - Highways
  - Transit systems

  - Irrigation projects
  - Tunnels
  - Treatment and distribution facilities for water
  - Collection and treatment for wastewater
  - Hyperloop
  - Bigger building
  - Longer bridges
  - Alvarado Water Treatment Plant
  - My Waterway Punggol, Singapore
  - Burj Khalifa building Dubai
  - Millau Viaduct bridge

Electrical Engineering



- that generally deals with the study and application of electricity, **electronics**, **circuits**, **electrical systems** electromagnetic **waves**,
  - Generators
  - Computers
  - **Lights**
  - Solar panels
  - Wind turbines
  - Microwave
  - Sustainable energy
  - Alternative energy
  - smartphones

- Hyperloop
- **sensors**
- Television
- **Communication systems**
- **GPS**
- Electrical motors
- LED
- Nuclear Power Plant
- **Wireless signals**
- **Radio signals**

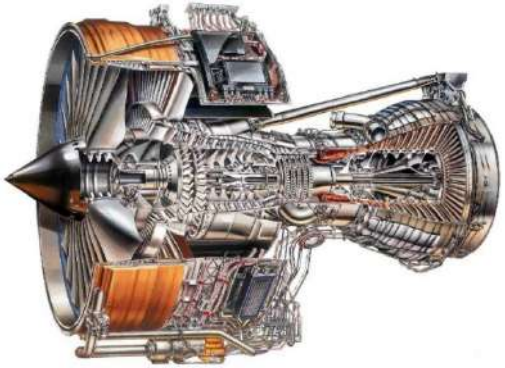
Mechanical Engineering

Deals with **machines** and mechanical systems

Deals with **motion**, **force**, and the use of **energy**

- A *machine* is a tool containing one or more parts that uses energy to perform an intended action

- Cars
- Airplanes
- Engines
- Wind turbines
- Air conditioner
- Manufacturing plants
- Robotics
- Excavators
- Crane
- Submarine
- computers
- Power tools
- Kitchen appliances
- Earthquakes effects on structures
- Aerodynamic of airplanes



- Renewable energy systems (solar and wind power)
- HVAC systems (**heating and cooling**)

Electronical and Mechanical Engineers

Most projects need both electronical and mechanical engineers working together.

- Satellites
- Cars
- Wind energy
- Solar energy
- Printers (regular and 3d printers)
- Airplanes
- Rockets
- Computers
- Almost everything

Many More Engineering Disciplines besides Four

There are many other engineer disciplines besides the big four which are chemical, civil, electrical and mechanical.

The other engineering disciplines are derived from…

A. an extension of a discipline

B. a specialization a discipline

C. Or a combination of multiple engineering discipline

PLTW | Engineering

Stop

Aeronautical Engineering

- Deals with flight and the movement of fluids in the earth's atmosphere.
- Specializing in the following work areas:
  - Aerodynamics
  - Propulsion
  - Controls
  - Structure

PLTW | Engineering

Aerospace and Astronautical Engineering

- Deals with environments not found on Earth
- Specialization in work areas centered on
  - Propulsion cryogenics
  - Materials navigation
  - Thermodynamics cosmic radiation

PLTW | Engineering

Agricultural Engineering

Agricultural engineering blends engineering knowledge with soil systems, land management, and environmental control.

Five specialty fields:

1. Soil and water
2. Food
3. Power machinery
4. Structures
5. Electric power generation

PLTW | Engineering

Architectural Engineering

- Works with architects focusing on structural integrity and safety of design
- Structural engineering and this field are very similar; the main difference is the concern for aesthetics

PLTW | Engineering

Automotive Engineering

- Design and build all types of vehicles:
  - Automobiles
  - Trucks
  - Tractors
  - Bulldozers
  - Motorcycles

Addresses:

- Engine design
- Structural design
- Tire design

PLTW | Engineering

Biomedical Engineering

Bridges engineering, physical, and life sciences in identifying and solving medical and health-related problems

Three general divisions:

1. Bioengineering
2. Medical Engineering
3. Clinical Engineering

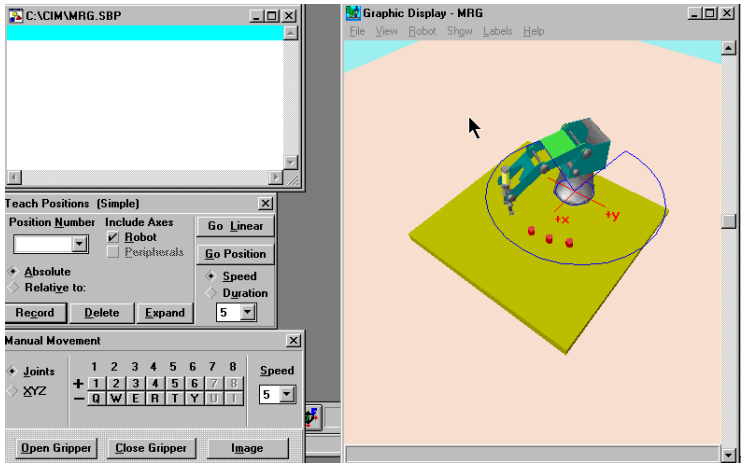
PLTW | Engineering

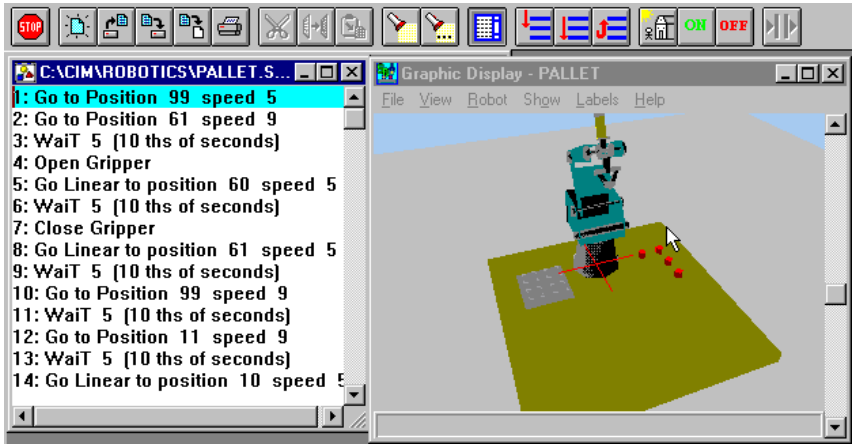
Computer Engineering

- The design and organization of computers:
  - Hardware
  - Software

Who is the largest consumer of computers today?

Automotive Industry

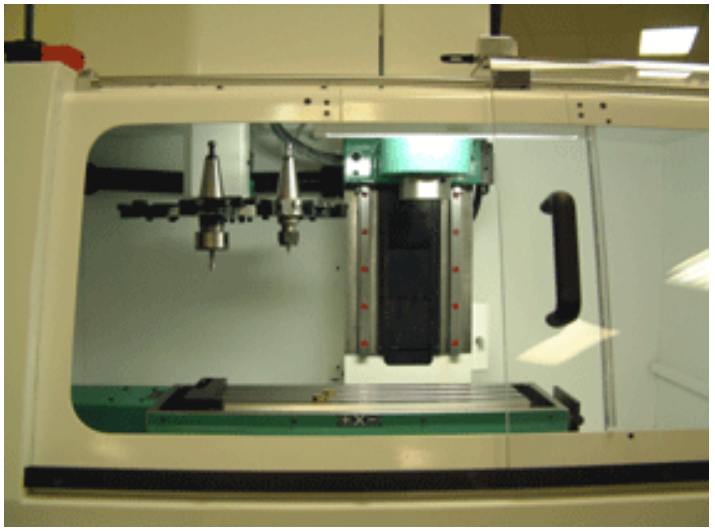




PLTW Engineering

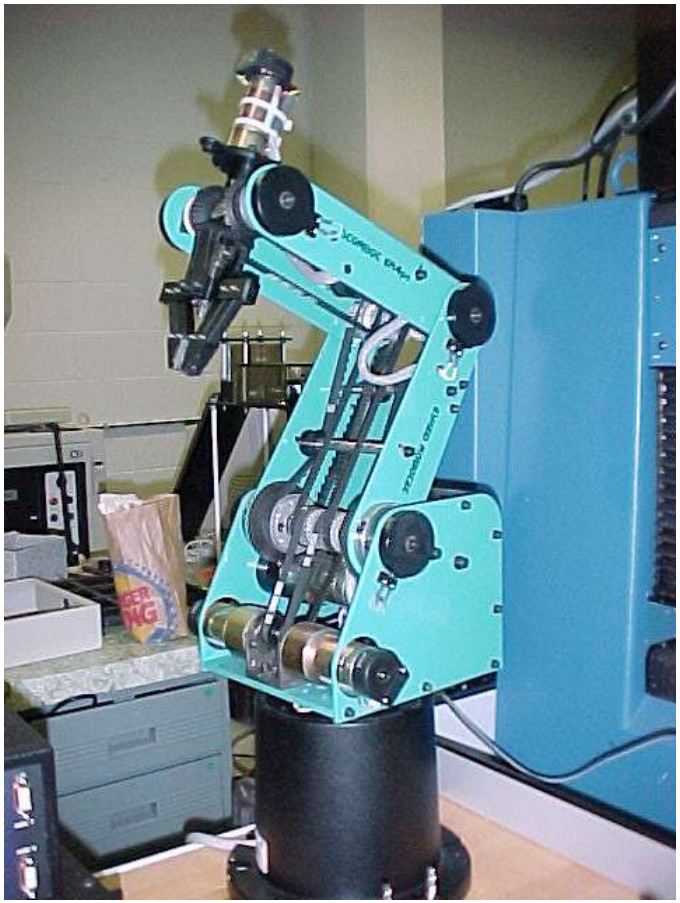
Industrial Engineering

- The design, improvement, and installation of integrated systems of people, materials, and energy to produce a product at the lower possible cost
- Deals with:
  - Design of systems for the manufacture of products
    - Raw materials to machines
    - Workforce to operate machinery
    - Removal of finished products
- Maintenance of machinery
- Analysis of manufacturing processes for cost



PLTW | Engineering

Manufacturing Engineering



- Design of a manufacturing facility for a product or products
- Deals with:
  - Physical plant layout
  - Use of existing machines or new
  - Purchase or rental of facilities
  - Purchase of nonproducing facilities and equipment
  - Packaging of product
  - Shipping to market

PLTW | Engineering

And many more…