HYDRAULIC SYSTEMS

In hydraulic systems, pressure is created using a piston. Pistons can be different sizes and hydraulic devices use pistons that are different sizes attached to each other with a flexible pipe. The Input piston is used to apply force to the fluid, which creates pressure in the fluid. The fluid transfers this pressure to the output piston. This pressure exerts a force on the output piston and the result is a mechanical advantage that makes the hydraulic system very useful.

The **mechanical advantage** in a hydraulic system comes from the fluid pressure in the system. Calculating the input force and the output force will give you the Mechanical advantage of the system.

MA = Output force / Input force

$MA = F_o x d_o / F_i x d_i$

PRESSURE and MECHANICAL ADVANTAGE

From Pascal's law, we know that the pressure the small piston creates is the same everywhere in the fluid. So the large piston has a larger area and is able to multiply the pressure because of its larger area. The force and area at each piston act as ratios that have to be equal.

$$\frac{\text{Force of the small piston}}{\text{Area of the small piston}} = \frac{\text{Force of the large piston}}{\text{Area of the large piston}}$$

$$\frac{F_{small}}{A_{small}} = \frac{F_{large}}{A_{large}}$$

By solving this ratio you will find that the forces created within a hydraulic system provides very large mechanical advantages - making them useful in many applications.

EVALUATION

Mechanical devices are constantly being evaluated to find ways they can be improved. The design and function of a mechanical device is related to its efficiency and effectiveness. What effect it has on the environment and how advancements in science through knowledge, trial and error can also help to stimulate change.
When a device has broken down or become ineffective in performing its function, making decisions as to what new device will replace the broken device have to be made with specific criteria in mind. The list of criteria you decide on will determine how well the replacement will meet your needs. The criteria might include:

- Use
- Purpose
- Cost
- Esthetics
- Workmanship
- Reputation

EVOLUTION

A machine can change and evolve over the course of many years. Change might be simple or complex depending on the evaluate criteria used to determine what needs to be improved. Improvements can make the device more convenient, cost effective, and efficient and can affect the people using it, as well as the environment. A history look at a simple device can show how trial and error can play a role in improving technology. Improvements usually don't happen by accident. Careful evaluation and creative designs to perform the function help make changes more effective and efficient. Questions about safety, convenience, environmental effect and recycling potential are all factors that contribute to improvements being made. What are you looking to improve upon in the device? This should be one of the first questions you should answer when evaluating a device.

EVOLUTION of the CAN OPENER

The pop can opener went through very distinct design changes. Each new design was the result of improving upon the previous design – which had a problem.

Can Opener Design	Advantages	Disadvantages
Iron Can **1810**	Kept things sealed	Had to be opened with a hammer and a chisel
Steel Can Late **1800's**	Opened with a **church key**  A simple lever	Needed to have a church key handy to open it
Aluminum Can **1958**	Can opened by wrapping the metal around a key the 'side-seamer' (1877) Lightweight	Sharp edges 
Removable Pull Tab **1963**	Ringed tab made it easy to open	Sometimes the ring detached from the tab and the can couldn't be opened It also caused a **litter** problem and a safety hazard – because of the sharp edges of the tab
Push Button Tabs Mid **1970's**	Litter problem was solved	Hard to push the small button open, consumers didn't like using cans with two buttons
Non-removable Pull Tab **1980** 	The '**ecology top**' – because the tab stayed attached to the can By wiggling it back and forth, it could be broken off	The ring would not puncture the tab, but would break off, but it is the best solution thus far

TECHNOLOGY and CHANGE

New materials and **new technologies**, human demands and environmental needs all contribute to the development of changes to current devices.

When failure occurs, **modifications** must also be made to ensure the device performs its intended function effectively, safely and efficiently.

Trial and error also can play a role in technological development. Early devices were usually operated by hand. Improvements to the device, by making it perform its task more easily, came as people tried to make the device perform more efficiently with less effort.

INVENTION leads to CHANGE

The invention of **electricity** has also contributed to improvements. Charles Coulomb first identified electric charges in the 1700's, but it took almost 100 years to make electricity widely available to major Canadian cities, and it took until the 1940's to make it available to most communities in Canada. As scientists and engineers learned more about this new energy source, they found ways to use it in new technologies, such as the **light bulb** and the **electron microscope**.

New technology can also develop from unrelated research. **MAGLEV** (Magnetic Levitation) trains operate on super-conductive magnets, powered by electricity. The technology for the MAGLEV resulted from physics experiments using particle accelerators which use large amounts of electricity to create powerful; magnetic and electric fields.

ENVIRONMENT

Since the early 1960's the environment has impacted technological development because people wanted to repair the negative impacts they had made on the environment.

New technologies (like *recycling*) were needed to prevent more damage.

Processing materials over and over or making them *biodegradable* would address some of the issues.

Other technologies (like *oil skimmers*) would help make environmental clean-up more effective and prevent further damage.

SOCIETY AND NEW TECHNOLOGY

Robots were originally popularized in movies and comic books. The word robot comes from the Czech word ***'robotnik'***, meaning workers, or slaves.

Robots today don't appear to be human-like, but they do the work of many humans, mostly in industry. The first practical robots were developed in the 1960's. Robots today weld car bodies together, diffuse bombs, perform surgery, help the handicapped and even explore other planets.

The drive to develop more effective and efficient robots came from the need to replace humans in the workplace. This was because humans were demanding more money for less hours of work and production costs were soaring. Industry decided to replace humans with robots – and most of these were just 'smart arms'.