



Guide Engineer Badge

Engineer Purpose: to promote your interest in the many aspects of engineering.

1) What is an Engineer?

A. **Engineers** apply the theories and principles of science and mathematics to the solution of practical technical problems. Often their work is the link between a scientific discovery and its use in everyday life. In addition to design and development, many engineers work in testing, production or maintenance. They supervise production in factories, determine the causes of breakdowns, and test manufactured products to maintain quality. They also estimate the time and cost to complete projects. Some work in management or sales where an engineering background enables them to discuss technical aspects of a product and assist in planning its installation or use.

B. Some types of Engineers are:

- ✿ **Civil Engineers** – Use physics, chemistry, and mathematics to design roads, bridges, and other structures
- ✿ **Structural Engineers** – a special area of civil engineering focussed on large buildings and structures requiring special considerations. For example, designs in earthquake prone areas.
- ✿ **Aerospace Engineers** – Apply theoretical knowledge from physics to design aircraft wings, engines, etc.
- ✿ **Chemical Engineers** – Apply chemistry research to produce useful products such as plastics, food, and medicines.
- ✿ **Electrical Engineers** – Apply physics and mathematics to create power systems, controls, and program software.
- ✿ **Mechanical Engineers** – Use knowledge from physics and chemistry to deal with systems such as heat, water, and other building services. Also create tools and parts.
- ✿ **Environmental Engineers** – Apply theoretical knowledge from environmental science to minimize the impact of man-made structures and products on the environment. This could involve controlling water running into a stream from a parking lot or designing a way to clean up factory waste.



2) Examples showing the work of an engineer:

Collect as many examples as possible. Take them to your meeting. Let the girls look at them and discuss how they are used. (Part 3 – common uses). Lead this into a discussion for part 5 (Name some devices and materials that have made life better for people).

- A. Simple Machines - make work easier. Six types: inclined plane, wedge, screw, lever, wheel & axle, pulley.
- Inclined plane:** ramp, wedge, handicap ramp, loading truck ramp. (*An inclined plane has work done on it.*)
- Wedge:** lock & key, axe, scissors, electric shaver, manual can opener, zipper, plow. (*A wedge is an inclined plane that does work.*)
- Screw:** Vice, corkscrew (with wooden handle), micrometer, faucet, drill. (*A screw is an inclined plane wrapped around a cylinder or shaft/pole.*)
- Lever:** bottle opener, wheelbarrow, pliers, scissors, nutcracker, hammer and nail, fishing rod, tweezers, nail clippers, staple remover, scales, manual typewriter, piano, parking meter. (*A lever is a bar that pivots (turns) on a point (fulcrum) and lifts a load. There are three classes of levers. Class 1: fulcrum between load & effort (amount of work used to lift load) – example is seesaw. Class 2: fulcrum is on one end of bar, load is between fulcrum & effort – example is bottle opener or nutcracker. Class 3: fulcrum is on one end, effort is between load & fulcrum – example is fishing pole or broom.*)
- Wheel & axle:** screwdriver, sardine can, steering wheel, faucet, wrench, waterwheel, windmill. (*A wheel & axle move together.*)
- Pulley:** crane, block & tackle, escalator, elevator, clothesline. (*A pulley is a grooved wheel with a rope or cable on it that moves a load. There are two types of pulley systems: fixed and movable. Fixed is pulley attached to support and load is attached to one end of rope/chain; typically you are pulling down on the rope to lift the load up. Movable is one end of rope attached to support and load is attached to pulley, which moves along rope; typically you are pulling up on the rope to lift the load up.*)
- B. Pocket Calculator – uses circuit boards and batteries (Electrical & Chemical Engineering)
- C. Chemical Reaction – Combine two or more substances (reactants) to create a new substance (resultant). Try making slime with borax and white glue. (See instruction sheet)
- D. Model Airplanes – Make one or more types of flying toy (see instruction sheets). Have a contest to see which goes farthest.



3) Other common uses of the items examined in part 2 above? – Discussion

4) Construct something that shows some engineering principles.

- ✿ Collect the necessary materials for a variety of engineering challenge activities. (See instruction sheets for Balloon Rockets, Design a Strong Arm, Tallest Tower, and Book Balancing).
- ✿ Have the girls work in patrols to design and build solutions to the challenges. After each challenge, evaluate the designs to see what worked best.

5) How have things created by engineers made life better for people?

- ✿ Brainstorm a list of “engineered” products & services that we use regularly. Examples might include: roads, cars, bicycles, airplanes, electricity, plumbing, factories, etc.
- ✿ Have the girls work in small groups or patrols to create a skit or poster showing what they think life would be like without one of these things. Present their skit or poster to the rest of the group.