ENGINEERING CAMPOREE

An exciting agenda of activities and challenges this year will focus on engineering. Many activities can be applied towards the Engineering Merit badge. To complete the Engineering Merit Badge, troops will need to complete requirements 1 and 2 either before or after the camporee. All other requirements will be completed at the camporee.

We will need the assistance in staffing the camporee. Each Troop is asked to provide two adults to volunteer to work on the Camporee Staff. We will issue assignments for these individuals at the Roundtable prior to the Camporee.

Events:

Campsite Gateway
Troop provides the materials. Simple machines should be included in the design. The more functional simple machines incorporated within the gateway, the more points earned in the judging. Simple machines include: levers, wheel and axles, pulleys, inclined planes, wedges, and screws (screwing the gateway together does not count).

Pop Bottle Rocket (Engineering MB Requirement 5b and 6g)
Patrols will assemble a "2 liter Bottle Rocket" at the camporee. Construction guidelines are provided at the end of this packet. Patrols are encouraged to be creative with their designs. Each patrols' rocket will be inspected by our expert panel of Rocket Engineers. The panel will consider: creativeness, functionality, and construction within guidelines. The rocket should be decorated to demonstrate unit and Patrol Pride.

The challenge is to build a two-liter pop bottle rocket that can out-fly the competition. The launch for distance contest winner will have the highest average of three launches. Not only must your design fly far, it must survive multiple launches. The following materials will be provided: Hot glue guns and sticks, rulers, utility knives, cutting boards, sharpie pens, and bottle stands. Patrols must bring the following materials: 3 two liter pop bottles, 3' x 2' piece of corrugated cardboard, 1 roll of duct tape, 250 grams of modeling clay, and paint or markers to decorate the finished design. The design is limited only to the materials listed. Please read the enclosed rocket design materials and procedures and create a diagram your rocket design prior to the camporee. Construction of the pop bottle rocket must be done at the camporee and may not begin until the event judges put their engineering stamp of approval on the blueprints. The fuel for the pop bottle rockets is water and compressed air. The rocket launcher, air compressor, and water will be provided at launch time.

Paper Tower Building
Tower must be able to stand alone with no assistance. (Taping to table is not allowed). The tower will be measured from table base to tallest point of the freestanding tower. Wind is in play and it is part of the challenge. Every participating patrol or crew will be given the following:

- Sheets of 20lb paper.
- 12 inches of 1 7/8 inch wide masking tape.
- Scissors.

These materials are the only items allowed to construct your paper tower. The tower must be able to support itself. This is a timed event and you will be given ten minutes to construct your tower. You will be told when to start and stop.

Solid Fuel Rocket Closest to the Pin
A solid fuel rocket "Closest to the Pin" contest will be an exciting event for participants and spectators. There will be two divisions: patrol and open for individual or small groups of all ages. Materials and rockets will be provided for the patrol competition. Individuals or small groups must bring their completed solid fuel rocket and required materials for two launches in the open division. Adjustments will need to be made with each launch to achieve a "Closest to the Bull's-

Eye Pin" touchdown. Individuals or small groups may sign-up after arrival at the camporee. We will have several launch pads available at the launch area.

Patrol Division: All scouts will launch the same type of rocket and engine provided by the Camporee program fee. Each Patrol will have two chances to land on the bull's-eye pin. The patrol will determine the location to place the launcher in order to hit the bull's-eye pin.

- 2 launches for each patrol
- Distance will be measured in feet and inches.
- Rocket must land within the target zone to get measured (Approx. 250 ft. Radius)
- Awards for closest to the bull's-eye pin landing.
- Camporee will have several launcher pads on site, you may bring your own if you wish

Open to All Competition: The individual or small group must provide their own rocket, launching materials and engines. No limitations on rockets. Follow the same rules listed above. Scout built rockets in this category will be awarded for closest to the bull's-eye pin. Adult built rockets will be recognized for bragging rights only.

Slingshot Egg Launch

Patrols will construct a device to protect your egg from impact. Materials Provided:
18 x 18 inch square of single ply cardboard
1 paper towel
18 inches of 1 7/8 inch masking tape
They will launch the container from a large slingshot. They must launch the container over an established horizontal rope for minimum height and the container must travel an established minimum distance to be counted.
Awards will be given for the farthest distance without breaking the egg.

Civil Engineering (2 stations)

Scouts will meet with civil engineers who will teach structural principles like I-beams, cantilevers, compression, and tension. The Scouts will then be challenged to use their knowledge to rapidly assemble an 8 foot truss bridge or an 8 foot suspension bridge strong enough for them to cross. They will be provided with photos of an actual completed bridge to help them put it together. Awards will be given according to time and ability to properly construct the bridge. In addition, engineering merit badge requirements 3, 4, 7, 8, and 9 will be covered at these stations.

Paper Airplane Golf with an Engineering Twist

- Golfers will sign in and show the officials their planes they plan to use. Standard 8.5x11 paper (NO Card Stock) will be provided and all planes must be made at the sight
- Scouts may bring printed templates for their planes as long as they show the officials before folding them into a plane.
- Each player may have up to three planes to use for the game.
- The course will have nine (holes) the actual hole will be a hula hoop placed on the ground
- Scores will be kept by each group of three or four players so the honor system will apply. (If possible, groups will be made of mixed troops or patrols)

- The first throw will be made by all in the group with the next throw being made by the furthest from the hole as in the real game of golf.
- More rules will be available at the event and officials will be available to answer questions.
- The following resources may be helpful:
  http://www.funpaperairplanes.com/
  http://www.paperaeroplanes.com/
  http://www.paperairplaneshq.com/
  http://www.amazingpaperairplanes.com/

Laser Gun Electrical Engineering (Engineering MB Requirement 6e)

- Scouts will show how integrated circuits sounds can easily be changed to exciting Star Wars sounds by doing the following:
- Build a circuit following a diagram and teaching material provided.
- When the circuit is assembled correctly and the slide switch is closed a laser gun sound should start.
- The Diagram and circuit parts will be a distance of 20 feet away from each other; they must stay where they are at.
- The patrol must assemble the circuit. Time stops once the laser gun sounds.
- You may run back and forth, talk or use any means at your disposal to assemble the circuit
- The only rule is the diagram and parts must stay where they are.
- Award will be given for fastest time.

Skits

We strongly encourage all troops to participate with a Rocket or Engineering themed skit at the campfire on Saturday night. All skits must follow the BSA National Standards for Skits. Skits must be outlined and submitted for approval prior to the campfire.

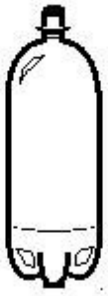
Water Bottle Rocket

What is a Water Bottle Rocket? A water bottle rocket is a 2-liter (soda) bottle with compressed air (for safety reasons we keep the air pressure at 80 psi) and water released in a downward direction.

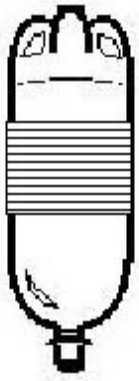
Construction

Almost any 2 liter bottle will work. The tube should slide snugly into the nozzle of the bottle forming a nearly air tight seal.

#1 Main Body/Pressure Chamber



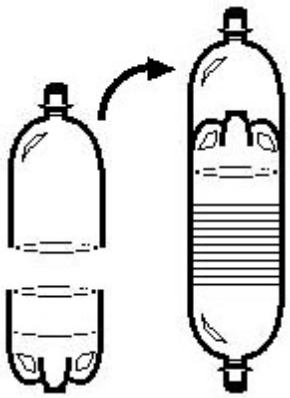
The main part of your rocket is the body or PRESSURE CHAMBER. Peel the label off your bottle and try to clean the glue residue the best that you can. Do NOT use a knife or other object to scrape the label off. Scrape marks can weaken the plastic. Also, do not use hot water the plastic may shrink and weaken the bottle. Some people have tried to use chemical solvents to remove the glue residue on the bottle. This might alter the walls of the bottle and make them too brittle or soft. Therefore we don't recommend it.



#2 After Cleaning

When launching, the pressure inside the bottle will cause the walls to expand. This expansion leads to a loss of energy and will make the rocket fly to a lower altitude. To solve this problem take some or duct tape, strapping tape, or packing tape and pre-wrap three bands around the pressure chamber. You don't want the tape to be too bulky and watch for wrinkles. This will strengthen the walls of the bottle without adding too much mass and launch altitude will increase overall.

#3 Nose Cones



Nose cones are not only for performance but add character and style to your rocket. Be sure to take some time thinking out the design of your rocket before committing to a plan of action. Shown here are only two examples; so don't be afraid to be creative. The "Bertha Series" nose cones are easy to make. The "Bertha" nose cones are made by cutting the bottom off a **spare bottle** with a pair of scissors and attaching the top portion onto the pressure chamber. **(Note: Never cut the pressure chamber)** To mark a straight line around the bottle for cutting, place the bottle on a bottle stand and hold a marker at the desired height as you rotate the bottle. Before attaching the nose cone, add a small lump of modeling clay in the bottle's neck to increase the mass (see section on Rocket Concept). After the modeling clay is pushed in place, tape over it with some duct tape and replace the cap. Once you launch the rocket and see how it hits the ground you will understand the reason for the tape. Make sure you have a cap on the nose cone. Before you tape the cone on, roll the rocket

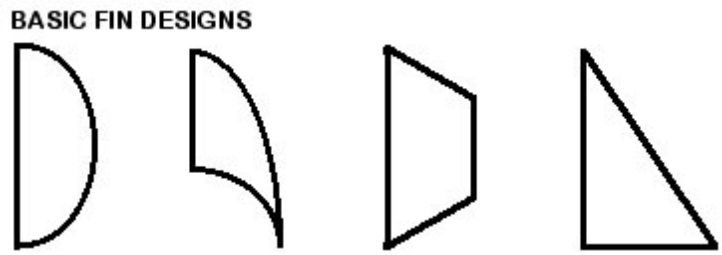
over a flat surface to make sure the cone and pressure chamber align. A curvy rocket will not be safe coming off the launcher.

This rocket is called "The Bullet". It is the easiest to make but lacks flight stability, this can be fixed to a degree by pressing a small lump (a few ounces) of clay to the inside of the nose cone. This will add mass to the cone and keep your rocket from flipping end over end while in flight. The cone is made from the middle section of an extra two liter bottle. Secure the cone with tape and attach to the bottle with tape. **(Note: do not puncture or cut the pressure chamber).** For more detailed instructions, see the section on Center of Mass and Center of Area.

#4 Fins

Fins are the guidance system for your rocket. Without them a rocket would tumble end over end. Fins can give your rocket life and beauty. However, fins tend to be the single greatest downfall of many young rocket builders. With the incredible speeds and acceleration generated at launch, many fins get ripped off the rocket body within a fraction of a second. Fins should be firm; if they flop around they are useless.

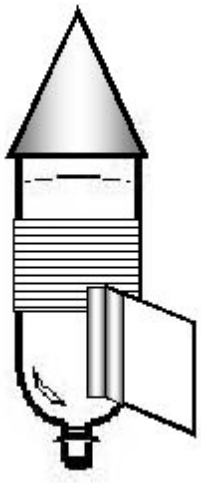
Materials: (remember lightweight but sturdy) Duct Tape, Corrugated Cardboard.
How many fins do I need? To ensure stability and safety, the minimum number of fins on a rocket is three (3). Many people choose a 3 or 4 fin design. There is no maximum number of fins you may have but keep in mind that the more fins you have the more drag you will create and drag slows a rocket down.



Constructing fins:
Be creative and cut out 3 or 4 identical fins. You can use any shape except "forward swept" fins. The size of the fin does matter! The best rockets fly well with long and narrow fins. After cutting the fins out of corrugated cardboard, lay the fin on a flat surface and laminate the entire fin surface with tape to reduce the amount of water damage to the fins.

Fin placement:
The fins of your rocket can't be placed above the halfway point of your pressure cylinder. You want to place your fins at the base of the rocket to lower or maintain the center of gravity. If you were to place the fins above the center of gravity, the rocket would tumble and spin out of control once it left the launch pad. Fins cannot be placed lower than the curved section near the neck of the bottle. If they are lower than this, the rocket will not fit on the launch pad.

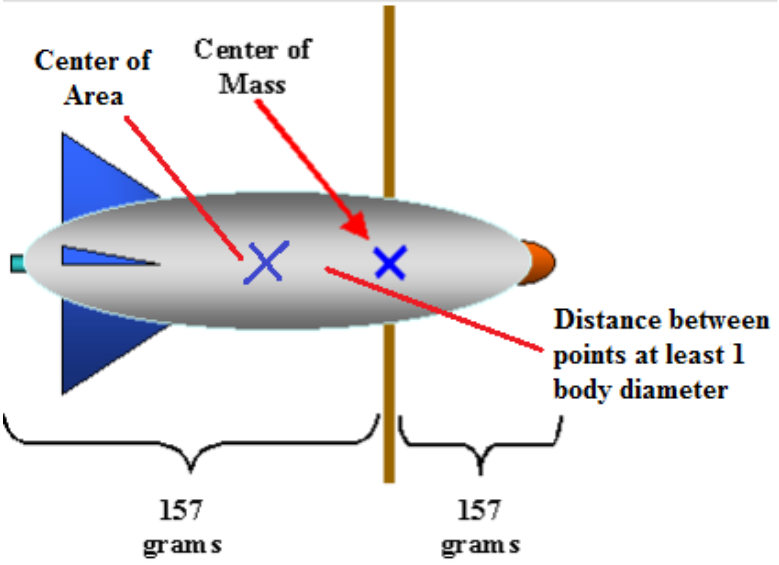
Attaching the fins:



Fins should be adequately secured; duct tape works well. Do not use glue because it does not expand with the pressure chamber and may cause them to pop off. Glue may be used to temporarily hold the fins in place, but they should be reinforced with duct tape. To find the location of the fins on the bottle, take a piece of string and wrap it around the outside of the bottle and mark the length using an ink pen. Remove the string from the bottle and lay it out in a straight line and mark the string in 3 or 4 equal lengths depending on the number of fins you are going to use. Wrap the string around the bottle again and transfer the marks to the bottle. If you are using 4 fins this will create 90-degree angles, 3 fins will be at 120-degree angles. To mark a straight line on the bottle, lay it in a door jam and use the straight edge to draw a line the length of your fin. You now have the locations of where to attach your fins. Apply a piece of tape to the paper clip or index card tabs and carefully tape them to your rocket. Look at your fin. Make sure it doesn't curve or it isn't crooked. It should be in a direct line with the body of your rocket. If it isn't perfect, take it off and try again. Attach the other fins. Test the wiggle of the fins. Your fins shouldn't wiggle more than a few centimeters from side to side. Adding more tape to the top and bottom areas of the fin might fix this problem.

#5 Center of Mass and Center of Area

By placing a clay ball or weight in the nose cone the Center of Mass is moved high enough on the rocket so that it won't tumble on lift off. If the center of mass of your rocket is too close to the center of area, your rocket will cartwheel out of control. It will NOT fly straight! Moving the center of mass up away from the midpoint of the rocket will help to ensure that the rocket flies straight. Here is a way to tell if your rocket will tumble. Measure the Center of Mass and mark this spot on your rocket. The best way to determine Center of Mass is to balance your rocket on a yardstick. To measure the center of area, cut out a silhouette of the finished rocket in corrugated cardboard. Next use a screwdriver to poke three widely spaced holes in the silhouette. Ream the holes out so the silhouette rotates freely on the screwdriver. Hang a weighted string on the screwdriver. Trace the line created by the string on the silhouette. Do this for all three holes. Where the three lines intersect is the center of area. Measure and transfer this point to your rocket. The center of mass should be at least the width of your rocket body in front of the center of area. If necessary, add additional modeling clay inside the nose cone near the tip until you achieve the appropriate separation.



Engineering merit badge requirements

1. Select a manufactured item in your home (such as a toy or an appliance) and, under adult supervision and with the approval of your counselor, investigate how and why it works as it does. Find out what sort of engineering activities were needed to create it. Discuss with your counselor what you learned and how you got the information.
2. Select an engineering achievement that has had a major impact on society. Using resources such as the Internet (with your parent's permission), books, and magazines, find out about the engineers who made this engineering feat possible, the special obstacles they had to overcome, and how this achievement has influenced the world today. Tell your counselor what you learned.
3. Explain the work of six types of engineers. Pick two of the six and explain how their work is related.
4. Visit with an engineer (who may be your counselor or parent) and do the following:

   a. Discuss the work this engineer does and the tools the engineer uses.
   b. Discuss with the engineer a current project and the engineer's particular role in it.
   c. Find out how the engineer's work is done and how results are achieved.
   d. Ask to see the reports that the engineer writes concerning the project.
   e. Discuss with your counselor what you learned about engineering from this visit.

5. Do ONE of the following:

   a. Use the systems engineering approach to make step-by-step plans for your next campout. List alternative ideas for such items as program schedule, campsites, transportation, and costs. Tell why you made the choices you did and what improvements were made.
   b. Make an original design for a piece of patrol equipment. Use the systems engineering approach to help you decide how it should work and look. Draw plans for it. Show the plans to your counselor, explain why you designed it the way you did, and explain how you would make it.

6. Do TWO of the following:

   a. *Transforming motion.* Using common material or a construction set, make a simple model that will demonstrate motion. Explain how the model uses basic mechanical concepts like levers and inclined planes to demonstrate motion. Describe an example where this mechanism is used in a real product.
   b. *Using electricity.* Make a list of 10 electrical appliances in your home. Find out approximately how much electricity each uses in one month. Learn how to find out the amount and cost of electricity used in your home during periods of light and heavy use. List five ways to conserve electricity.
   c. *Understanding electronics.* Using an electronic device such as a mobile telephone or portable digital media player, find out how sound travels from one location to another. Explain how the device was designed for ease of use, function, and durability.
   d. Using materials. *Do experiments to show the differences in strength and heat*

conductivity in wood, metal, and plastic. Discuss with your counselor what you have learned.

e. *Converting energy.* Do an experiment to show how mechanical, heat, chemical, solar, and/or electrical energy may be converted from one or more types of energy to another. Explain your results. Describe to your counselor what energy is and how energy is converted and used in your surroundings.

f. *Moving people.* Find out the different ways people in your community get to work. Make a study of traffic flow (number of vehicles and relative speed) in both heavy and light traffic periods. Discuss with your counselor what might be improved to make it easier for people in your community to get where they need to go.

g. *Building an engineering project.* Enter a project in a science or engineering fair or similar competition. (This requirement may be met by participation on an engineering competition project team.) Discuss with your counselor what your project demonstrates, the kinds of questions visitors to the fair asked you about it, and how well were you able to answer their questions.

7. Explain what it means to be a registered Professional Engineer (PE). Name the types of engineering work for which registration is most important?
8. Study the **Engineer's Code of Ethics**. Explain how it is like the Scout Oath and Scout Law.
9. Find out about three career opportunities in engineering. Pick one and research the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.