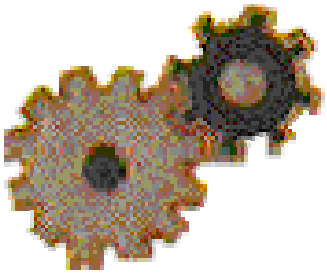
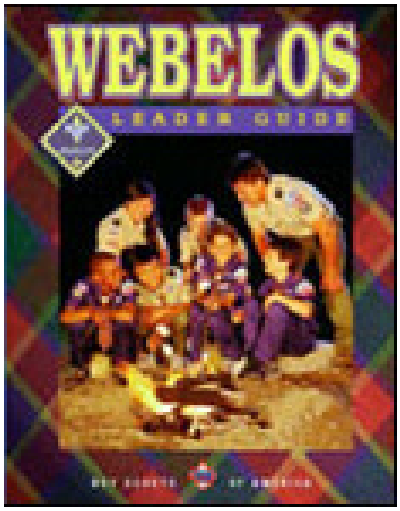
Webelos Activity Badge

Engineering



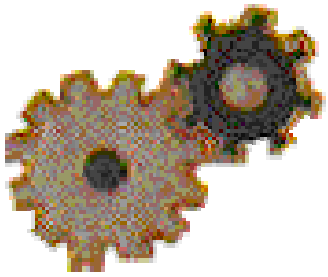


Prepared By:

Rich Smith

Cubmaster Pack 133

January 3, 2006



Engineer

Do Both of These:

1. Talk to an engineer, surveyor, or architect in your area about the different occupations in engineering. Create a list that tells what they do
2. Draw a floor plan of your house. Include doors, windows, and stairways.

And Do Four of These:

3. Visit a construction job. Look at a set of plans used to build the facility or product. Tell your Webelos Den Leader about these. (Get permission before you visit.)
4. Visit a civil engineer or surveyor to learn how to measure the length of a property line. Explain how property lines are determined.
5. Tell about how electricity is generated and then gets to your home.
6. Construct a simple working electrical circuit using a flashlight battery, a switch, and a light.
7. Make drawings of three kinds of bridges and explain their differences. Construct a model bridge of your choice.
8. Make a simple crane using a block and tackle and explain how the block and tackle is used in everyday life.
9. Build a catapult and show how it works.
10. While you are a Webelos Scout, earn the Cub Scout Academics belt loop for **Mathematics**

Engineering Signoff

Requirement							
Do both of these requirements:							
1. Talk to an engineer, surveyor, or architect about occupations in engineering.							
2. Draw a floor plan of your house.							
And do four of these requirements*:*							
3. Visit a construction job.							
4. Visit a civil engineer or surveyor to learn how to measure the length of a property line.							
5. Tell about how electricity is generated and then gets to your home.							
6. Construct a simple working electrical circuit using a flashlight battery, a switch, and a light.							
7. Make drawings of three kinds of bridges. Construct a model bridge of your choice.							
8. Make a simple crane using a block and tackle.							
9. Build a working catapult.							
10. Earn the Academics belt loop for **Mathematics**							

Engineer Word Search

Directions

Find the words in the puzzle that are listed below.
The words are horizontal, vertical, and diagonal, forwards and backwards.
All of the words are associated with the Engineer Activity Badge!
Put the unused letters in the boxes to find a hidden message!

H M E A S U R E M E N T S B
A I E L E C T R I C I T Y R
L W G N I D L I U B E A M I
A N Y H C O N S T R U C T D
S A S T W C A T A P U L T G
B L O C K A N D T A C K L E
A P U D O Y Y M E T A L S N
T R H A R M A C H I N E S G
T O T N A L P L E E T S D I
E O V C I R C U I T B N M N
R L P R O P E R T Y L I N E
Y F G H J R O C K E T S H E
S M A D A O R L I A R I C R

H I D D E N M E S S A G E

[ ][ ][ ][ ][ ][ ] [ ][ ][ ][ ][ ] [ ][ ][ ][ ] !

BATTERY
BEAM
BLOCK AND TACKLE
BRIDGE
BUILDING
CATAPULT
CIRCUIT
COMPUTER
CONSTRUCT
DAMS
ELECTRICITY
ENGINEER
FLOOR PLAN
HIGHWAY
MACHINE
MEASUREMENTS
METALS
PROPERTY LINE
RAILROAD
ROCKETS
STEEL PLANT

Rich Smith
2/13/03

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B L O C K A N D T A C K L E
A P U D O Y Y M E T A L S N
T R H A R M A C H I N E S G
T O T N A L P L E E T S D I
E O V C I R C U I T B N M N
R L P R O P E R T Y L I N E
Y F G H J R O C K E T S H E
S M A D A O R L I A R I C R

H I D D E N M E S S A G E

A L W A Y S S T U D Y H A R D !

BATTERY
BEAM
BLOCK AND TACKLE
BRIDGE
BUILDING
CATAPULT
CIRCUIT
COMPUTER
CONSTRUCT
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MEASUREMENTS
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PROPERTY LINE
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STEEL PLANT

Rich Smith
2/13/03

Fields Of Engineering

Aeronautical Engineering: Deals with the whole field of design, manufacture, maintenance, testing, and the use of aircraft both for civilian and military purposes.

Astronautical Engineering: Closely related to aeronautics, but is concerned with the flight of vehicles in space, beyond the earth's atmosphere, and includes the study and development of rocket engines, artificial satellites, and spacecraft for the exploration of outer space.

Chemical Engineering: Concerned with the design, construction, and management of factories in which the essential processes consist of chemical reactions.

Civil Engineering: Perhaps the broadest of the engineering fields; deals with the creation, improvement, and protection of the communal environment; providing facilities for living, industry, and transportation, including large buildings, roads, bridges, canals, railroad lines, airports, harbors, and other constructions.

Electrical Engineering/Computer Science: Divided broadly into the engineering of electrical power distribution systems, electrical machinery, and communication, information, and control systems.

Geological & Mining Engineering: Includes activities related to the discovery and exploration of mineral deposits and the financing, construction, development, operation, recovery, processing, purification, and marketing of crude minerals and mineral products.

Industrial or Management Engineering: Pertains to the efficient use of machinery, labor, and raw materials in industrial production.

Mechanical Engineering: Broadly speaking, covers the design and operation of all types of machinery and small structures.

Safety Engineering: Concerned with the prevention of accidents.

Sanitary Engineering: A branch of civil engineering that has acquired the importance of a specialized field due to its great importance for a healthy environment, especially in dense urban population areas.

Some Engineering Functions

Research: A search for new scientific knowledge, with the objective of applying it to solving problems.

Development: Applied research which results in working model.

Design: Conversion of developed ideas into economical, reliable, and producible plans of manufacture, use or construction.

Maintenance: Plan and direct the methods of making the design and transforming it into a useful product.

Sales: Define and explain the application of the product and the sale of it.

Management: Administrate any or all of the engineers which perform the functions listed above and any other personnel required to perform the assigned task.

Engineering Activity Badge

Engineering Careers

Requirement 1

Interview an Engineer

1. What type of Engineer are you?

   _____

2. What does that type of Engineer do?

   _____

   _____

   _____

3. What other jobs can this type of Engineer have? (Research, Sales, etc.)

   _____

   _____

   _____

4. What education is needed for this type of Engineer?

   _____

   _____

5. What other types of Engineers do you work with?

   _____

   _____

6. What do those types of Engineer do?

   _____

   _____

   _____

   _____

Engineering Careers

The Right "Person" for the Job!

Use a word from this list to fill in the correct answer.

Aeronautical	Chemical	Computer	City	Agricultural
Electrical	Metallurgical	Industrial	Mechanical	Civil

1. An engineer who designs plants to make water safe to drink - _____.
2. An engineer who designs machines in a factory - _____.
3. An engineer who tests new processes and checks old ones in a chemical plant - _____.
4. An engineer who plans new circuits and directs workers in an electrical plant - _____.
5. An engineer who designs and tests new space techniques - _____.
6. An engineer who designs and tests new techniques for new equipment for industry - _____.
7. An engineer who designs and tests equipment for farmers and ranchers - _____.
8. An engineer who tests new processes and checks old ones in a steel plant - _____.
9. An engineer who designs bridges and roads - _____.
10. An engineer who designs programs and new computers - _____.

Engineering Careers

The Right "Person" for the Job!

Use a word from this list to fill in the correct answer.

Aeronautical	Chemical	Computer	City	Agricultural
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1. An engineer who designs plants to make water safe to drink - **City**.
2. An engineer who designs machines in a factory - **Mechanical**.
3. An engineer who tests new processes and checks old ones in a chemical plant - **Chemical**.
4. An engineer who plans new circuits and directs workers in an electrical plant - **Electrical**.
5. An engineer who designs and tests new space techniques - **Aeronautical**.
6. An engineer who designs and tests new techniques for new equipment for industry - **Industrial**.
7. An engineer who designs and tests equipment for farmers and ranchers - **Agricultural**.
8. An engineer who tests new processes and checks old ones in a steel plant - **Metallurgical**.
9. An engineer who designs bridges and roads - **Civil**.
10. An engineer who designs programs and new computers - **Computer**.

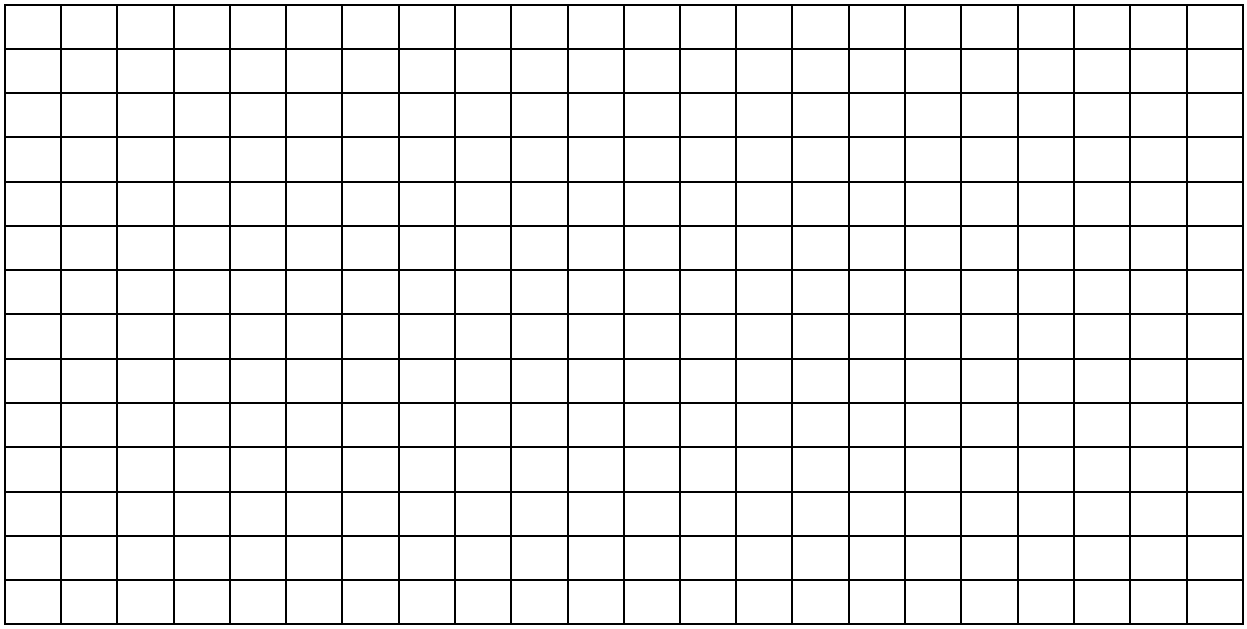
Engineering Activity Badge

Floor Plan

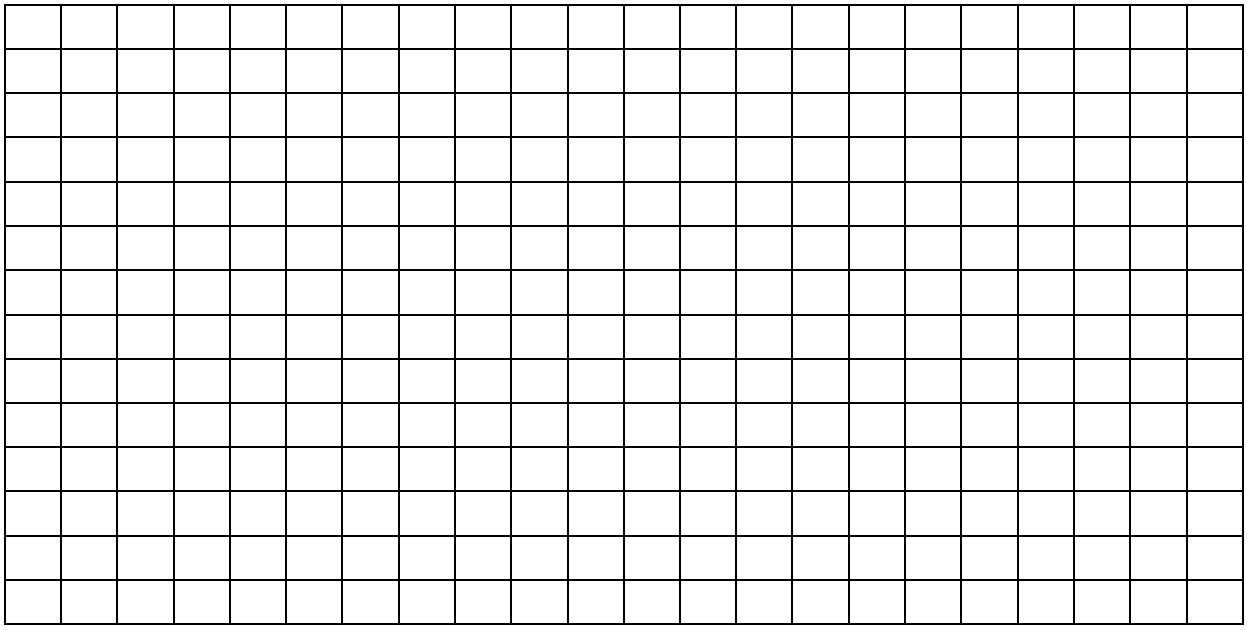
Requirement 2

Draw a floor plan of your house. Include doors, windows, and stairways.

First Floor



Second Floor



Engineering Activity Badge

Surveying Land

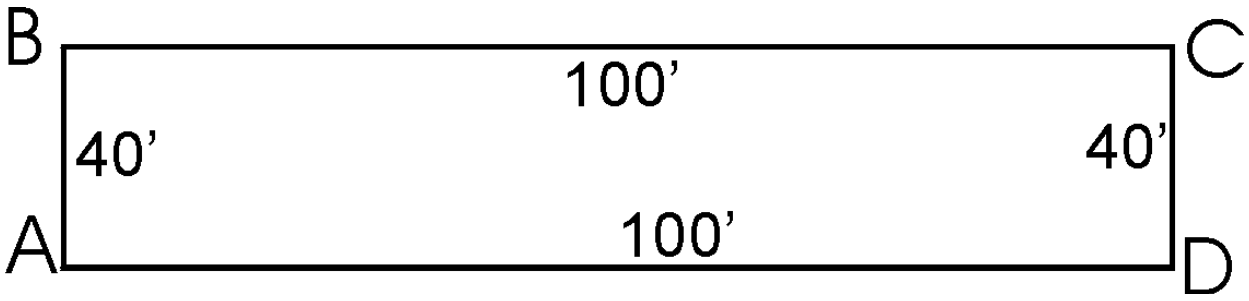
Requirement 4

All land surveys tie into a "Bench mark". The benchmark is a bronze disk about two inches in diameter indicating the location and elevation of its position. The city engineer for your city will be able to tell you where the benchmarks are located within your city or area. You can survey an area near your Den site even without knowing where the benchmark is located. Start by using the fixed point marked by a colorful rag held in place by a nail pushed into the ground.

To do this demonstration, you will need a compass, a 2x4 approximately three feet long, and a 50- or 100-foot long tape. Start at one corner of the area to be surveyed. Take a reading of your compass setting at the top of the 2x4 and measure the distance to the next point. Do this around the area that you have chosen to survey, making sure that you mark down the compass setting and linear distance between each pair of points.

- 360 degrees North 40' Points A to B
- 90 degrees East 100' Points B to C
- 180 degrees South 40' Points C to D
- 270 degrees West 100' Points D to A

If possible, try to get a surveyor's transit to show the Webelos. This transit works much the same way as the above demonstration but also gives degree readings in elevation as well as horizontal.



Engineering Activity Badge

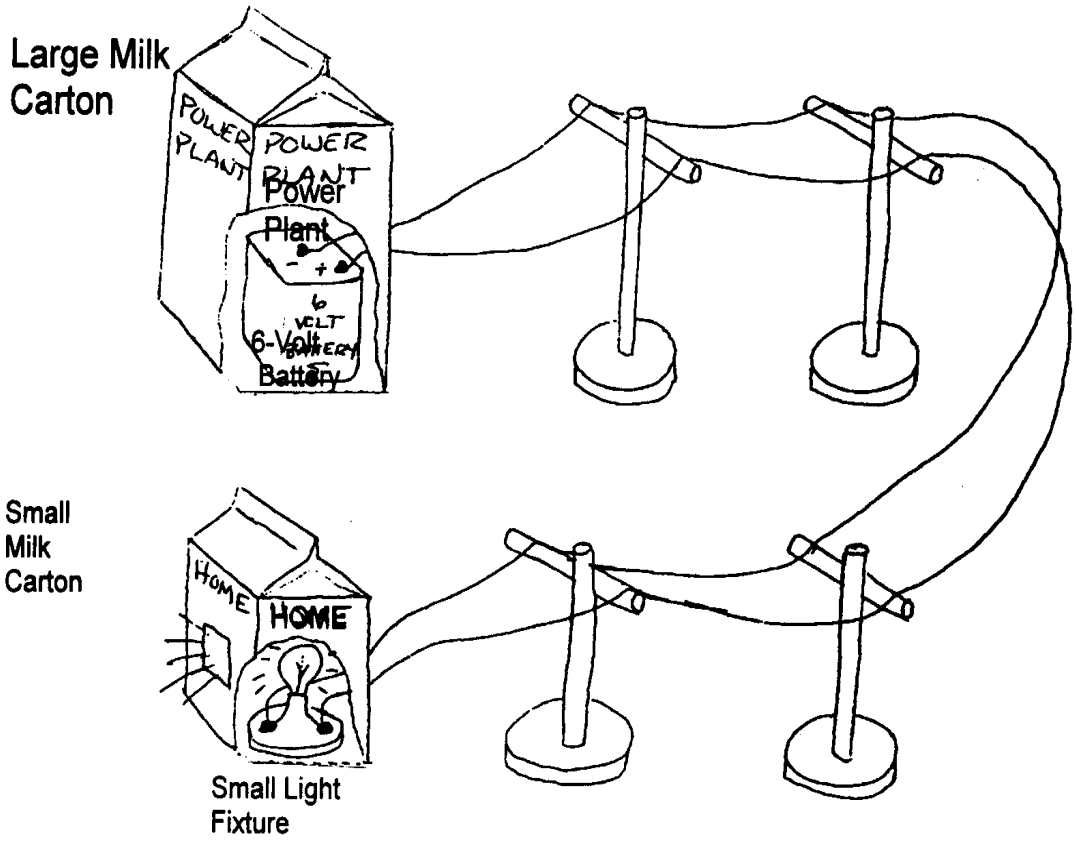
How Electricity Comes to Our House

Requirement 5

Make a small scale electrical system

Equipment:

6 Volt Battery	Wooden Dowels
Insulated wire	2 - Milk Cartons
Small Light fixture	



Engineering Activity Badge

Electrical Circuit

Requirement 6

Do It Yourself Flashlight

This flashlight can be assembled easily and provide a fun project for the boys. And better yet, it actually works!

Materials:

Flashlight battery

Bulb

Plastic pill bottle with a flexible lid

Insulated wire

Directions:

1. The pill bottle should be large enough for the battery and bulb base to fit inside it. The wire should be the kind that can be bent easily. Scrape the insulation from one end of your wire and form it into a flat coil.
2. Attach the coil to the bottom of the battery with adhesive tape.
3. Cut an opening in the center of the pill bottle lid, so that the base of the bulb will fit. Push base of bulb through hole in lid.
4. Scrape the other end of the wire and wind it around the base of the bulb. Secure in place with some tape.
5. Crumple small pieces of paper. Place enough of this in the bottom of bottle so that when battery is inserted and the lid is tightly in place, the bottom of the bulb will just make contact with the raised center top of the battery.
6. Hinge one side of the lid to the bottle with tape.
7. When lid is closed, the bulb will light. To shut off your flashlight, flip the lid up. This light creates a dim glow. If you want a larger light, use two batteries in a larger container.

Bridges

Baltimore Area Council

The earliest bridges were probably a log fallen across a stream. Someone probably learned that several logs side by side made it wider and easier to cross. You could make a longer bridge by putting logs or slabs of stone across stepping-stones over a wider stream. These are the same principles that are used in many modern bridges.

Make a plank bridge out of a piece of poster board or a cereal box 10 inches long and 4 inches wide. Place it between two blocks or thick books. See how many toy cars it will support. Now bend the sides up 1/2 inch from the sides like handrails. See how many toy cars it will now support.

What you have done is changed a plank bridge to a beam bridge. It acts like a much thicker plank without the weight or expense of more material.

Beams are thick at the center where more weight is supported and thinner near the ends where there is less weight. The beams are usually made lighter by making them out of lots of small triangles. The beams are started at the center and built out on both sides equally to maintain balance like a seesaw.

Try this experiment to see why triangles are used. Nail the ends of four scrap boards together to form a frame. Use only one nail per corner. See how easily this four sided structure collapses? This is how a bridge would act made from a shape other than triangles. Now nail a board on a diagonal between two corners across the frame to form two triangles. See how much stronger it is?

Arch bridges are some of the longest lasting in the world. Some are over 1,500 years old! The arch can be entirely over the roadway, entirely under the roadway, or in the center. You can make a pretty good model of an arch bridge by using a hole saw, like you would use to drill a hole for a door knob, and drilling holes in a board. Cut this out with a cut through the center of the holes and you have the two sides of an arch bridge. Place another board on top for the road the draw and paint the stones on the side.

Bridge Activity

Baltimore Area Council

Have boys build two demonstration bridge side frames - one of rectangles and one of triangles. Use stiff cardboard or thin wood and brass fasteners. Have them experiment to see which type of bridge is stronger.

Hollow Tubes

Circle Ten Council

To demonstrate the strength of hollow tubes, try laying a brick on a Styrofoam cup lying on its side. Place another cup on its rim and add bricks (2 to 3) until it crushed. Glue four cups together rim to rim and bottom to bottom with white glue and allow glue to dry. Place bricks (usually 4) on top until the structure crushes. Demonstration shows why engineers use columns in structures and bridges.

Places to visit:

- Visit an operational drawbridge, grain elevator, ship or grain loading operation, or other large industrial operation involving large cranes or other lifting equipment.

Den Activities:

- Ask your local Boy Scout troop to give a demonstration of some of the skills needed for the Pioneering Merit Badge. One particular item of interest would be to see a rope monkey bridge being lashed together.
- Ask Webelos to look through books and magazines at home and bring in pictures of bridges. Note the difference in construction.
- Have the boys **find pictures of different bridges** and bring them to a Den meeting. The differences in many kinds of bridges will become apparent as the boys study them and construct models. The simplest ones are plank, beam, pier, deck, truss, and arch types. The more complex kinds are the bascule (the old castle drawbridge type). vertical lift, cantilever, and pontoon. Many swinging bridges are in use today.

The Five Machines

Machine #1: The Lever

Every lever has one fixed point called the fulcrum and is acted upon by two forces, the effort and the load. There are three classes of levers:

First Class has the fulcrum placed between the effort and the load.
An example is a crowbar.

Second Class has the load placed between the fulcrum and the effort.
An example is a nutcracker.

Third Class has the effort applied between the load and the fulcrum.
An example is a pair of tongs.

Machine #2: The Wheel and Axle

The invention of a lever that could be rotated a full 360 degrees is the wheel and axle.

- One of man's first uses for this elementary machine was a windlass.
- Other examples include a steering wheel, a screwdriver, and a faucet handle.

Machine #3: The Inclined Plane and Wedge

Ramps, sloping roads and chisels are examples of this machine. The inclined plane is nothing more than a wedge cut in half. The wedge does its job by moving. The inclined plane is held stationary while the "wedge material" is moved over it.

Machine #4: The Pulley

The pulley can be grouped into three types: fixed, moveable and block & tackle.

Machine #5: The Screw

A Greek mathematician worked out the geometry of the spiral helix around 200 BC and laid the groundwork for the screw.

The screw can function in two principal ways: it can raise weights or it can press or fasten objects.

Pulleys

Pulley: A pulley is a simple machine made with a rope, belt or chain wrapped around a grooved wheel.

A pulley works two ways. It can change the direction of a force or it can change the amount of force. A fixed pulley changes the direction of the applied force. (Example: Raising the flag). A movable pulley is attached to the object you are moving.

Activity

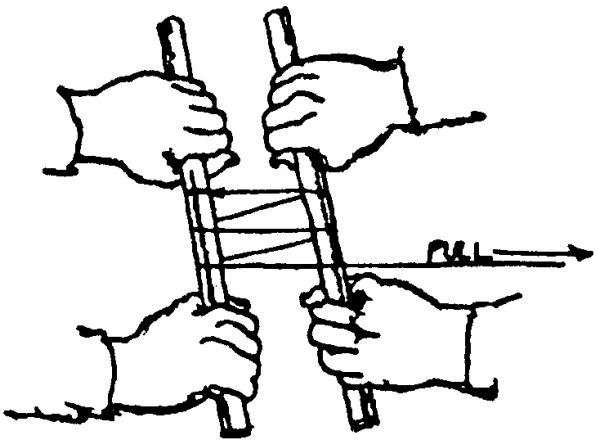
What happens when you increase the number of pulleys?

Materials:

1. Three Scouts
2. Two broom handles
3. One ten foot long piece of twine or rope

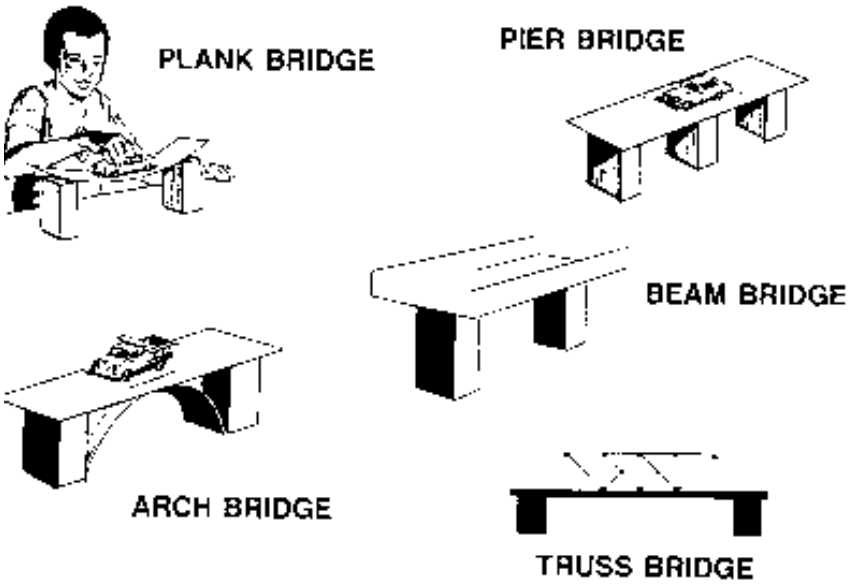
Directions:

1. Have one Scout tie the end of the twine onto one of the broom handles.
2. Have two of the Scout stand about two and one half feet apart so that the broom handles are held about two feet apart.
3. Wrap the twine around the broom handles twice.
4. Have the third Scout pull on the twine as the other two students try to hold the broom handles apart.



5. Now wrap the twine around the broom handles two more times and repeat step 4.

Bridges and Machines

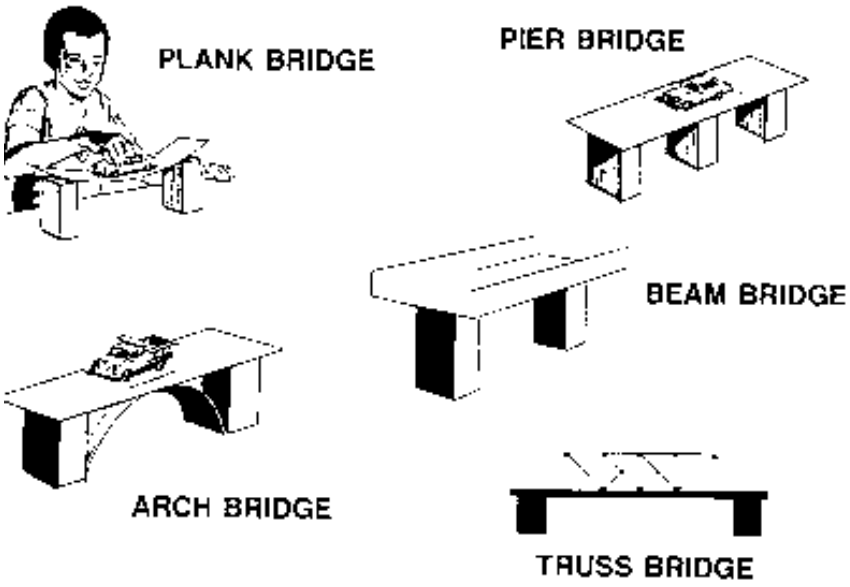


Use a word from this list to fill in the correct answer.

Catapult	Pulley	Beam Bridge	Plank Bridge	Truss Bridge
Arch Bridge	Suspension Bridge	Lever	Block & Tackle	Pier Bridge

1. A flat surface over two supports - _____.
2. A flat surface over three or more supports - _____.
3. A flat surface over an arched support - _____.
4. A flat surface with turned up edges - _____.
5. A bridge with sides made up of a series of triangles - _____.
6. A bridge that hangs from strong strung cables - _____.
7. A pulley(s) and a rope or cable - _____.
8. A slingshot or other device used to project something - _____.
9. A device to help lift things easier using leverage - _____.
10. A device to help move things easier a rope or cable - _____.

Bridges and Machines



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Catapult	Pulley	Beam Bridge	Plank Bridge	Truss Bridge
Arch Bridge	Suspension Bridge	Lever	Block & Tackle	Pier Bridge

1. A flat surface over two supports - **Plank Bridge**.
2. A flat surface over three or more supports - **Pier Bridge**.
3. A flat surface over an arched support - **Arch Bridge**.
4. A flat surface with turned up edges - **Beam Bridge**.
5. A bridge with sides made up of a series of triangles - **Truss Bridge**.
6. A bridge that hangs from strong strung cables - **Suspension Bridge**.
7. A pulley(s) and a rope or cable - **Block & Tackle**.
8. A slingshot or other device used to project something - **Catapult**.
9. A device to help lift things easier using leverage - **Lever**
10. A device to help move things easier a rope or cable - **Pulley**

Engineering Activity Badge

Building a Bridge

Requirement 7

Suspension Bridge - Hanging By A Thread

Upon completing this project, your Den will have built a suspension bridge. The instruction seems long and complicated, but it isn't really. Use the illustrations as a guide.

Materials needed:

Heavy cardboard 2' x 4'

4 bricks or wooden blocks

Large ball of strong string

Yardstick

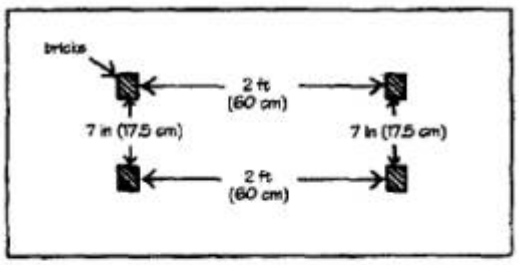
Duct tape or heavy tape)

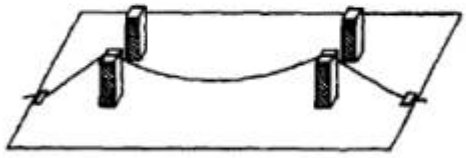
Scissors

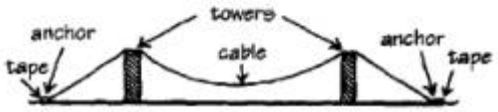
Lightweight cardboard 6" x 5'

Directions:

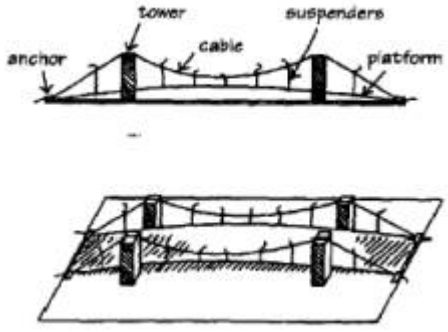
1. Place the heavy cardboard on a firm surface. This is the base for the bridge.
2. Place the 4 bricks on end on the cardboard base so they form the corners of a rectangle 7" wide and 2' long. These are the towers.
3. Tape one end of the string to one 2' edge of the cardboard in line with one of the bricks. This is the anchor. Drape the string over the top of the brick, straight across the space between the bricks, and over the opposite brick. Leave enough string so that it hangs down between the bricks about 3". Tape the loose end of the string to the opposite side of the cardboard. This will form the other anchor. Cut the string. The length of string hanging between the bricks is called the cable.







4. Do the same thing on the other side of the bridge, using the other two bricks. Make sure this string hangs down the same distance as the first cable. You now have two cables.
5. Carefully slide the lightweight cardboard so it stretches the length of the bridge and lies between the bricks. This will be the platform, or roadway.
6. Cut seven 12” pieces of string. Tie one end of each piece of string every 4” along one of the cables. These are your suspenders.
7. Slide each of the suspenders under the lightweight cardboard. Tie the free end of each of the suspenders to the other cable. The suspenders closest to the towers should be longer than those in the middle of the bridge. In the middle of the bridge the platform should be suspended about 3" above the cardboard base. Trim the excess string from the suspenders.
8. Now that the platform is hung, gently bend the ends so that they touch the cardboard base. Tape the ends to the base. You now have a road that goes across a suspended bridge. You have created a suspension bridge. The suspenders take the weight of the platform up to the cables. The cables then carry this weight to the towers and the anchors. The weight of the platform pulls upward on the anchors and downward on the towers. The towers are strong rigid structures, like your bricks, so they can support a lot of weight. The anchors need to be well secured to a firm object (usually land). Suspension bridges use much less material than traditional bridges and can span large distances.

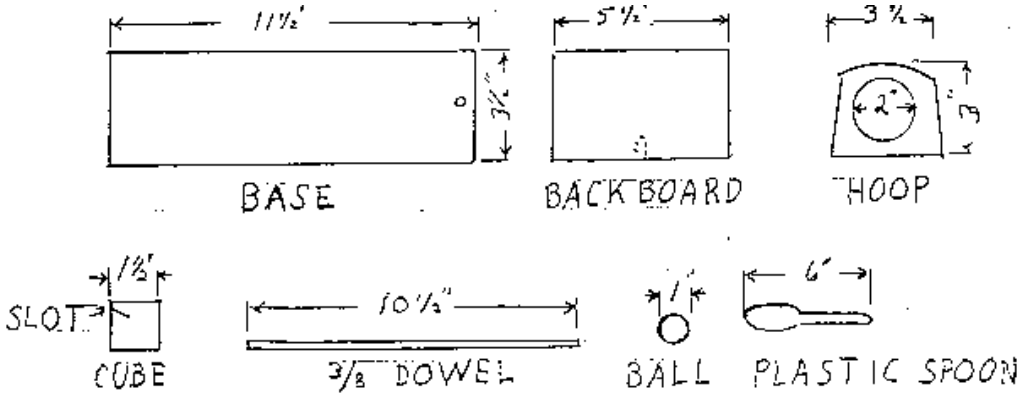


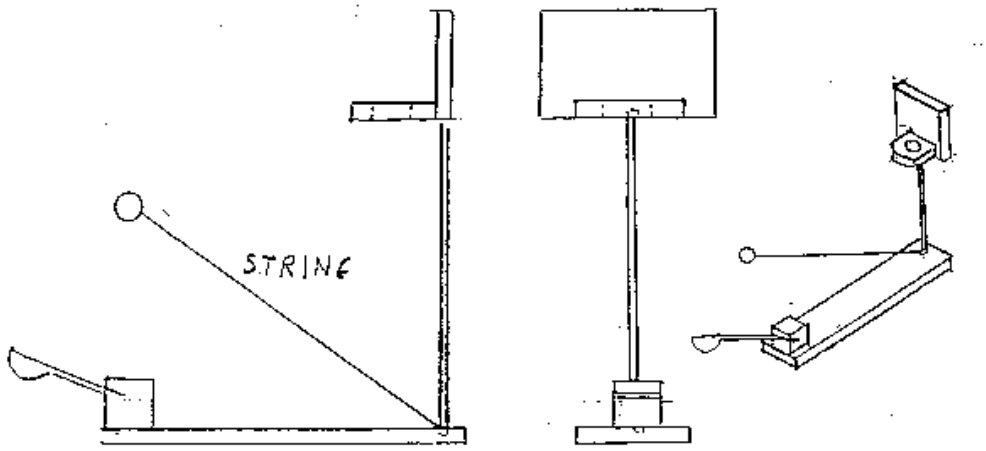
Engineering Activity Badge

Build a Catapult

Requirement 9

Basketball Catapult





Instructions

1. Base, backboard and hoop are made from a 1"x4" board.
2. Drill holes in base and backboard 3/8" diameter and 1/2" deep.
3. Cut a slot at a 15 degree angle in a cube block large enough for the handle of a plastic spoon.
4. Cut hole for the hoop first; then finish cutting the hoop piece.
   (We used a slice of 2" diameter PVC pipe and screwed it into backboard.)
5. Glue the hoop to the backboard; then glue dowel rod into backboard and base.
6. Glue cube block to base and insert spoon into slot.
7. Cut string and attach one end to dowel rod at base and the other end to any 1" sized ball (ping pong balls work well).

Song

Engineer

Tune: London Bridge

Need a special engineer?
I know one -- he is near.
Webelos can fix the gear.
They can do it!

Block and tackles lift up weight,
Pull the rope, watch it raise,
Fast and easy, be amazed,
Webelos can do it!

Catapults are big slingshots,
In olden days they threw big rocks,
We prefer balloons that pop,
Webelos can do it!