

GITEA
PROBLEM
SOLVING
COOKBOOK
VOLUME 1

Compiled by:
The Georgia Industrial
Technology Education Association

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This book of Problem Solving Activities has been compiled by the Georgia Industrial Technology Education Association. Members of our professional organization have contributed ideas and activities that work in their classrooms and laboratories. We hope that these activities will be beneficial to you in your classroom or laboratory situation.

Please feel free to reproduce any portions of this booklet or the entire book to use in your classes or to share with other Technology Education professionals. GITEA is working to improve and enhance Technology Education in Georgia. We appreciate this opportunity to share our ideas with you.

For additional information or if you have ideas and activities that you would like to and are willing to share with us please send to:

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Special Thanks

We would like to thank the members of GITEA who have contributed their knowledge, time and resources to the production of this 3rd edition of the GITEA Problem Solving Cookbook. Without your help and support this endeavor would not be possible. It is our hope that this book will be beneficial to all Technology Educators.

Through your help and support we will continue to be able to produce quality documents that will enhance the efforts of the classroom instructors. Your continued support is greatly appreciated.

The 1994-95 GITEA Executive Committee

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BALLOON CAR

OBJECTIVE

Students are to design and construct a car that is propelled by a balloon that will travel the farthest distance from the starting point.

MATERIALS

(Per Student)

1. Any non energy storing materials for the car construction
2. 12" balloon
3. Wheels
4. Axles
5. Masking Tape
6. Glue

TOOLS

1. Scissors
2. Ruler
3. X-acto Knife

LIMITATIONS

1. Car must be able to roll freely.
2. Car must be propelled by a balloon only.
3. Students may not utilize rubber bands, springs, mouse traps, etc... to propel the car.
4. Car must have a minimum of 3 wheels.
5. Students may not push the car.

INSTRUCTIONS

1. Car will be raced on a flat surface.
2. Car must be able to travel a minimum distance of 4 feet beyond the starting line.
3. Cars will be allowed 2 runs.
4. The car that travels the farthest distance will be declared the winner.
4. In case of a tie the winner will be the car that travels the straightest line perpendicular to the starting line.

CLOTHES PIN SHUTTLE

OBJECTIVE

Students will find a way to transport a clothes pin a distance of 10 to 15 feet.

MATERIALS

(Per Group)

1. 1 - Clothes Pin
2. 2 - Rubber Band
3. 1 - Balloon
4. 1 - Straw
5. 2 - Paper Clips
6. Masking Tape (6 inches)
7. 1 - Stationary string or fishing line that can be detached at either end.

TOOLS

1. Scissors

LIMITATIONS

1. The student will use only the materials provided.
2. The clothes pin must be transported the entire distance of line in a single movement.
3. The clothes pin must be powered by the given materials. It can not be thrown or pushed.
4. The fishing line must remain level.

INSTRUCTIONS

1. Groups of 2 or 3 students work best.
2. The students will design a device that transports a clothes pin from point A to point B.
3. The students may test their device as many times necessary.
4. The students will only gain full credit when they demonstrate their device for the instructor and it transports the clothes pin the entire distance on one movement.

CRASH CAR DERBY

Year after year automakers have made faster and faster cars capable of transporting more and more people from place to place. In the 1940's, 50's and 60's automobiles were "made to last" with rigid (stiff) frames, bulky body's made from thick sheet metal. No seat belts, metal dashboards, big steering wheels with small shafts in the center were standard. These cars survived a crash pretty well, unfortunately the people didn't.

Starting as early as the 60's, automotive engineers began to design cars to protect the passengers in a crash. Seat belts, 5 m.p.h.. bumpers, and lighter weight materials were introduced. Race cars were a moving test platform for several new concepts. A radical idea was to sacrifice the vehicle to protect the passenger. Indianapolis 500 cars are designed to disintegrate in crashes. Each part that separates from the main body of the race car takes with it a part of the energy that the vehicle had. Drivers have walked away from 200 m.p.h. crashes because of this.

Modern passenger cars advertise "crumple zones" that protect their passengers in head-on and rear-end crashes. They are called crumple zones because the ends of the lighter weight automobiles are designed to crumple up on impact, taking some of the energy away from the passengers during the crash. Think of it like how you would catch a fastball barehanded or how a shock absorber works.

OBJECTIVE

Students should use household items that would not present a safety hazard in class or to you as you are making the car (NO AEROSOL CANS) to design and produce a car that will protect it's passenger (a raw egg) from being damaged in a head-on crash.

MATERIALS

1. Any household items that would not present a safety hazard to yourself, while building or in class during testing. If there is a doubt ASK!

TOOLS

1. Ruler
2. Any tools necessary - to be determined by the instructor.

LIMITATIONS

1. You may not use pre-existing cars.
2. Size limits: The car **MUST** be within these specifications:
 - a. Height - 3"-4" tall
 - b. Width - 3"-4" wide
 - c. Length - 4"-6" long
3. Cars must have wheels that roll.

INSTRUCTIONS

1. Students will have one class period to complete their car.
2. Egg must be placed in a sealable plastic bag and into the car immediately before the test.
3. Car must be designed so that a quick check can be made (within ten seconds) to see if the egg survived the crash.
4. Eggs that survive the initial wall impact will receive full credit.
5. The test device is a bicycle innertube (cut so that it becomes a big rubber band) stretched between two table legs, one inch above floor level. Face the test device ten feet from a brick wall. Place color dots on the floor starting 12" from the straight innertube line and continuing at two inch intervals away from the rear of the test device on a center line perpendicular to the innertube.
6. The car must make contact with the wall to qualify. If the egg survives the initial impact it receives full credit and then advances to the next dot back until it cracks.

EGG DROP CONTAINER

OBJECTIVE

Students are to design and construct a cardboard container that will protect an egg.

MATERIALS (Suggested)

(Per Student)

1. Cardboard
2. Any type of packing materials.
3. Tape

TOOLS

1. Scissors
2. Ruler
3. X-acto Knife
4. Cutting Board
5. Markers

LIMITATIONS

1. Container must be 5 1/2" x 5 1/2" x 5 1/2".
2. Container may not be made of wood, metal, glass, plexiglass, or hard plastic.
3. Container must be made of cardboard.
4. Must be a real container - **no** parachutes, airfoils, etc....

INSTRUCTIONS

1. Container must have advertisements on all surfaces and they must reflect an electronics company. The outside of the box must have good eye appeal and look professional.
2. Students are to complete the container for homework (2 weeks).
3. Students will bring container to class for testing.
4. Container must be easily accessible for opening during testing.
4. Testing of container:
 - a. Sky Drop - 50' onto asphalt
 - b. Hammer Test - 12 pound spring loaded sledge hammer that hits the box.

Contact: Roger Ivey, Lilburn Middle School for information on the Hammer Test.

PAPER AIRPLANE DESIGN

(Accuracy)

OBJECTIVE

Students will design and build a paper airplane that will fly through a given target.

MATERIALS

(Per Person)

1. 1 - Piece of Graph Paper
2. 1 - Sheet of Paper (8 1/2" x 11")
3. 1 - Paper Clip
4. Scotch Tape (12 inches)
5. Colored Pencils or Markers (optional)

(For Testing)

1. 1 - Hula Hoop
2. 1 - Launching Device

TOOLS

1. Ruler
2. Scissors
3. Wire Cutters

LIMITATIONS

1. You may use only one sheet of paper for construction of your airplane.
2. You must have a launch hook on your airplane.

INSTRUCTIONS

1. Sketch the design/plan for your airplane on graph paper.
2. Build your airplane and decorate if desired.
3. Test your airplane design, by hand.
4. Make modifications to your design.
5. You will be allowed two attempts for your airplane to fly through the target.
The instructor will test each aircraft. (Note: A hula hoop makes a great target.)

PAPER AIRPLANE DESIGN

(Distance)

OBJECTIVE

Students will design and build a paper airplane that will soar the farthest distance.

MATERIALS

(Per Person)

1. 1 - Piece of Graph Paper
2. 1 - Sheet of Paper (8 1/2" x 11")
3. 1 - Paper Clip
4. Scotch Tape (12 inches)
5. Colored Pencils or Markers (optional)

(For Testing)

1. 1 - Launching Device

TOOLS

1. Ruler
2. Scissors
3. Wire Cutters

LIMITATIONS

1. You may use only one sheet of paper for construction of your airplane.
2. You must have a launch hook on your airplane.

INSTRUCTIONS

1. Sketch the design/plan for your airplane on graph paper.
2. Build your airplane and decorate if desired.
3. Test your airplane design.
4. Make modifications to your design.
5. You will be allowed two attempts for your airplane to fly through the target. The instructor will test each aircraft. (Note: You will need to mark the distance for each flight and keep the longest.)

PAPER BEAM

OBJECTIVE

Students will design and construct a paper beam that will support 30 pounds.

MATERIALS (Suggested)

(Per Student)

1. Any type of paper (i.e. cardboard, matte board, poster board, copy paper, construction paper, chip board, etc...).
2. Any type of adhesive (tape and staples not allowed).
3. Any type of coating material may be used to add strength (i.e. resin, glue, polyurethane, paint, etc...).

TOOLS

1. Scissors
2. Ruler
3. X-acto Knife
4. Cutting Board

LIMITATIONS

1. Light must be able to pass through the length of the beam.
2. Beam must be 1" x 1" x 12".
3. Beam must be made from a paper product.
4. Adhesive must be used - **no** tape or staples.

INSTRUCTIONS

1. Students are to have a complete lab report with the beam.
 - a. Sketch showing side and end view of the beam.
 - b. Materials list.
 - c. Written procedure of beam construction.
2. Students are to complete beam for homework (2 weeks).
3. Students will bring beam to class for testing.
4. Testing of beam:
 - a. Beam will span a distance of 10" between tables or desk tops.
 - b. Suspend a 5 gallon bucket with 30 pounds across the beam.
 - c. Beams that support the 30 pounds are satisfactory.

PAPER BRIDGE

OBJECTIVE

Students will design and build a bridge to span a given distance (5 inches).

MATERIALS

(Per Group)

1. 2 - Index Cards
2. 2 - Paper Clips
3. Masking Tape (6 inches)

TOOLS

1. Scissors
2. Ruler

LIMITATIONS

1. The bridge must have a span of 5 inches.
2. The roadbed must be at least 1 1/2 inches above the ground.
3. No part of the roadbed, or supports under the roadbed may touch to ground.

INSTRUCTIONS

1. This can be an individual or small group project.
2. The instructor will test the bridges by using weights such as quarters, dimes, and nickels. The weight will be applied to the center of the bridge until the bridge fails. Bridge failure is to be defined as the point where the roadbed touches the ground. Roadbed is that part that is meant to be traveled on.

PAPER PLATFORM

Bridges have it. Spider webs have it. Houses have it. A skeleton has it. The chair you are sitting in has it. They all have structure. Structure is how materials work together for strength. Since technologists first started building and producing structures to solve many of their day to day problems, there has been a constant effort to make less material do more work. Technologists take what materials are available, process them and assemble them in such a way that they will perform work efficiently. Limited supply, excessive weight, limited resources or access to those resources have always been problems to overcome in the building of a structure. With that in mind you are going to build a structure to solve a specific problem.

OBJECTIVE

Develop and construct a platform that will support the weight of a concrete block.

MATERIALS

(Per Group)

1. 4 - Index Cards
2. Masking tape (3 inches)
3. White glue

TOOLS

1. Scissors
2. Ruler

LIMITATIONS

1. Students may only use the materials provided.
2. The platform be within these specifications:
 - Height - 1/2" to 1" tall
 - Width - 2 1/2" to 3" wide
 - Length - 4" to 5" long

INSTRUCTIONS

1. Students may work individually or in groups.
2. Students will brainstorm solutions.
3. Students will construct a platform using the provided materials.
4. The instructor will test the platform at the end of the allotted time frame (usually 1 class period).
5. The structure must support a concrete block.

POSTER BOARD CAR

OBJECTIVE

Student will build a car from the material supplied that will hold the payload of two pink pearl erasers as it travels down a ramp and across a track. The success of the effort will be judged by the distance traveled past the bottom of the ramp.

MATERIALS

(Per Group)

1. 2 - Dowel Rods (1/8" x 3")
2. Poster Board (8" x 8")
3. 2 - Gem Clips
4. White Glue

(For Testing)

1. 2 - Pink Pearl Erasers

TOOLS

1. Scissors
2. Single Hole Punch
3. Pliers
4. Ruler

RAMP AND TRACK SPECIFICATIONS

1. The ramp is 36" wide x 36" long and is set at a 30 degree angle.
2. The track is 36 " wide by 36" long.

LIMITATIONS

1. The student will use only the materials provided.
2. The car will not be pushed on the ramp or track.
3. The car must have at least 3 wheels.
4. The payload (Pink Pearl Erasers) must stay in the car during the entire run.
5. The payload must be easily loaded and unloaded.

INSTRUCTIONS

1. Groups of 2 students works best.
2. The student will draw a sketch and label the parts and material of the car.
3. The students will receive the material and put their name on it.
4. The student will construct his/her car.
5. The ramp will be set up for practice runs the day before the race.
6. The student will get credit for the longest run made on race day.

RUBBER BALL SHOOT

OBJECTIVE

Students will build a device to shoot a rubber ball 10 feet and hit a target. The device must be mounted to a pad and the rubber ball cannot be thrown.

MATERIALS

(Per Group)

1. 1 - Launch Pad (A board approximately 12" x 12")
2. 4 - Rubber Bands
3. 4 - Straws
4. 6 - Thumb Tacks
5. 1 - 1" Hard Rubber Ball (like the ones found in gumball machine)
6. 4 - Paper Clips
7. 2 - 1/4" x 1/4" Wood Sticks
8. 1 - Paper Cup (Dixie Cup)
9. Masking Tape (6 inches)
10. Kite String (12 inches)

TOOLS

1. Scissors
2. Ruler

LIMITATIONS

1. The student will use only the materials provided, however, they do not have to use all materials.
2. The rubber ball cannot be thrown.

INSTRUCTIONS

1. Have each student sketch two possible designs.
2. Separate the students into groups of 3-4.
3. Allow students to discuss the various ideas and decide upon a design.
4. Distribute materials to the groups.
5. Have students construct their devices.
6. Set up target for students to practice (Bulletin Board Paper).
7. Final testing should be done on a chalk board. (The dust from the chalk will allow you to see where each ball hits the target.)

SHELTER DESIGN

The Space Exploration mission to Omicron Theta IV was dropped off on that planet 2 weeks ago, and started out living in the tents which they brought with them. Unfortunately, this has not been successful. There is one sort of large native bird, rather stupid, that always perches on any structure it sees. Since these birds weigh an average of 1,000 pounds each, this has resulted in several crushed tents, as well as two crushed explorers. Since the two who were killed were their design engineers, they have radioed back to us for our help.

The team has discovered that the only plant that grows there produces a sort of stiff, cardboard-like leaf (about 36" by 60"), a thin, pliable vine, and a sap which yields a sticky, gooey, glue-like substance when cooked. The mission has sufficient food for the 6 months they must stay there, but they must build some kind of shelter to replace the tents.

OBJECTIVE

Design the shelter for the Space Exploration Mission and build a model of the space station.

MATERIALS

1. 12 - Index Cards
2. String (24 inches)
3. Glue

(For Testing)

1. Weights of some sort (Books, Weights, Bricks, etc...)

TOOLS

1. Ruler
2. Scissors

LIMITATIONS

1. Your shelter must provide a floor and roof, and have an opening on at least one side.
2. You must have at least 25 square inches of floor space. (Account for space lost due to columns, etc.)
3. The inside height of the shelter should be at least 5 inches.
4. You may coat the walls, roof and floor with glue.
5. You may not fill the columns with glue.

INSTRUCTIONS

1. Groups of 2 or 3 students work best.
2. Students will brainstorm solutions.
3. Students will sketch a design for your shelter.
4. Students will construct their shelter model from the materials provided.
5. Students will submit their model for testing. (This will be done by slowly adding measured amounts of weight until the model begins to crush.)

SOLAR WATER HEATER

OBJECTIVE

Students will make a solar water heater that can raise the water temperature the greatest amount.

MATERIALS

(Per Person)

1. 1 - Glass jar with lid
2. 1 - Metal Can
3. Any additional materials that the student wishes to bring to help increase the water heaters efficiency. (Examples: mirrors, magnifying glasses, aluminum foil, etc...)

TOOLS

1. A Thermometer to check water temperature - preferably a scientific thermometer.

LIMITATIONS

1. The students should provide their own materials.
2. The can must fit into the jar when the lid is closed.
3. The can should be painted at home - allow students to determine color.
4. Students may bring any additional materials that they feel will enhance their project. Be creative.

INSTRUCTIONS

1. Attain a supply of cold water so that all water heaters begin at the same temperature.
2. Allow student to fill their cans with water - they determine the amount necessary.
3. The students should place the jar lid on their desk, a counter top, or table.
4. The students should sit the can with water into the jar lid.
5. The students should then invert the jar, place it over the can and tighten the jar into the lids. Be sure to remind the students the jar must remain inverted!
6. Have the students carry the water heaters outside and set them up. Allow them to place any additional materials as necessary.
7. Leave water heater outside for 20 to 30 minutes depending on the length of your class period.
8. Have students retrieve water heaters and bring them back inside for the temperature to be checked. Remind students not to open their containers.

STRAW TOWER

OBJECTIVE

Students will build a straw tower as tall as possible that can support the weight of a tennis ball.

MATERIALS

(Per Group)

1. 100 - Plastic Straws
2. Straight Pins (many)

(For Testing)

1. 1 - Tennis Ball

LIMITATIONS

1. The students will use only the materials provided.
2. The students may not cut the straws.
3. The tower must support the tennis ball for 30 seconds.

INSTRUCTIONS

1. Groups of 3 students work best.
2. The students will draw a design for their tower.
3. The students will then obtain 100 straws and a container of pins from the instructor.
4. The students will build their structure.
5. The instructor will test the towers at the end of the allotted time frame (usually 3 to 5 days).

TIME LINE

OBJECTIVE

Students will research various inventions and find out who the inventor was, the purpose of the invention and how the invention works.

MATERIALS

1. Worksheet
2. Pencil or pen
3. Posterboard
4. Markers
5. Ruler

INSTRUCTIONS

1. Students will be assigned an invention by the instructor.
2. The instructor should take the students to the library to research their topics.
3. The students will use the encyclopedias and various books in the library to find out information about their invention.
4. The students should find out the following information about their invention and fill in the information on their worksheet:
 - a. The inventors name(s).
 - b. The date the invention was created.
 - c. What is the purpose of the invention?
 - d. How does the invention work?
5. The students will design and complete a poster representing the invention. The name of the invention should be on the poster, the inventors name and the date it was invented. This can be use to create a time line about the room.
6. The students will give an oral presentation about the invention.

TIME LINE

(Suggested Inventions)

Adding Machine	Hearing Aid	Power Loom
Air Conditioner	Helicopter	Printing Press
Airplane	Hologram	Radar
Aluminum	Hovercraft	Radio
Assembly Line	Hydro-Crane	Railroad
Balloon	Hydrofoil	Rayon
Barbed Wire	Interchangeable Parts	Refrigerator
Barge	Internal Combustion	Revolver
Barometer	Engine	Robot
Bicycle	Jet	Satellite
Bifocal	Knitting Machine	Sewing Machine
Binary Code	Laser	Shingles
Brick	Laser Transit	Solar Collector
Bulldozer	Level	Sonar
Bunsen Burner	Locks	Spinning Ginny
Cannon	Mass Production	Steamboat
Canoe	Mechanical Reaper	Stethoscope
Car	Metal Lathe	Styrofoam
Cardboard	Micrometer	Submarine
Cash Register	Microphone	Suspension Bridge
Cathode Ray Tube	Milk Bottle	Tank
Compass	Modem	Telegraph
Computer	Morse Code	Telephone
Concrete	Movie Projector	Telescope
Conveyors	Nail Gun	Television
Cotton Gin	Nails	Thermometer
Diesel Engine	Neon Light	Thrasher
Electric Battery	Nylon	Train
Elevator	Offset Press	Transistor
FAX	Paper	Trolley Car
Fiber Optics	Phonograph	Typewriter
Fiberglass	Plastic	Video Tapes
Fuel Injection	Platform Scales	Vulcanized Rubber
Gatlin Gun	Plumb Bob	Waferboard
Glasses	Plywood	Wankel Engine
Glider	Pneumatic Guns	Weaving Machine
		Zipper

TIME LINE

Worksheet

Student's Name: _____

Invention: _____

Inventor: _____

Date Invented: _____

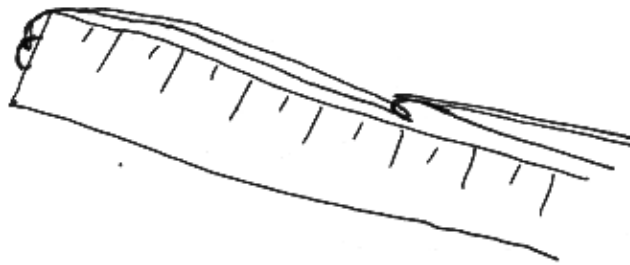
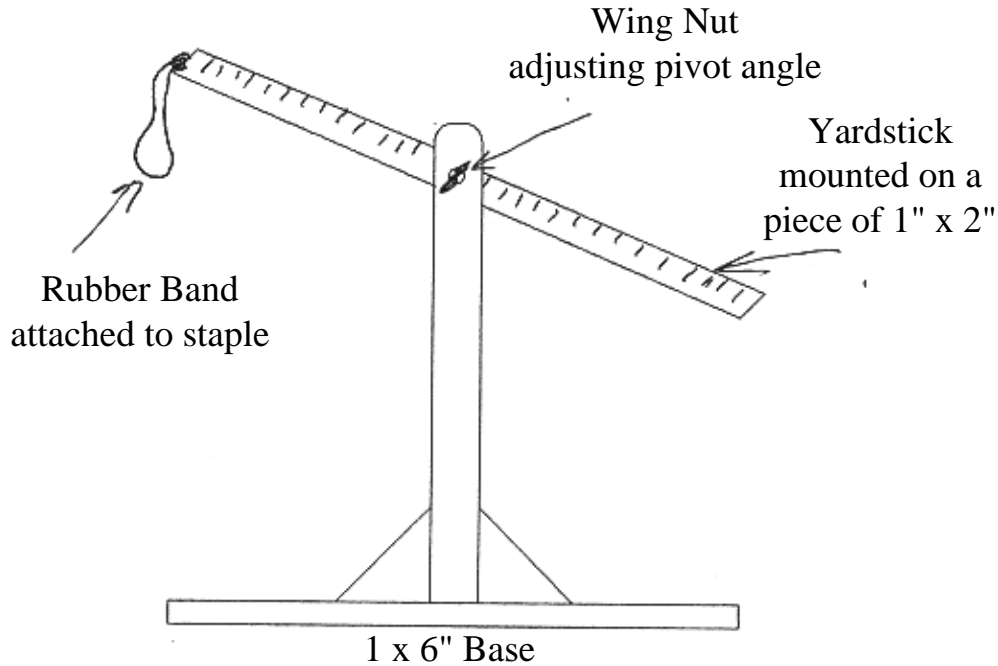
Resources used to gather data: _____

What is the purpose of this invention? _____

How does this invention work? _____

Airplane Launch Device

Tony Burton



Directions

Hook the launch hook to the rubber band. Pull all aircraft back to the same point on the yardstick. Release airplane. You may allow students to adjust the pivot angle.

