

Colorado Mathematics, Engineering, Science, Achievement

A program of the Colorado Minority Engineering Association



Basic Program Concepts MESA Advisor Handbook

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Background

Introduction

Thank you for agreeing to serve as a Colorado MESA advisor. Your role is to help students navigate the full array of opportunities available to them through our hands-on after-school science, technology, engineering and math based MESA program.

The challenge and the rewards of a MESA advisor lie in the diversity of needs, interests and experiences the students bring with them. As advisors, your role is to provide a compass for our MESA students; to challenge and stretch their minds; to be role models; to explore fields of science, technology, engineering and math; and to learn through experience.

This handbook is a resource and is intended as a guide for MESA advisors, with an emphasis on information relevant to implementing the program at your individual school. The handbook is hardly exhaustive. We have attempted to compile the essential components of the MESA program, including resources on meeting logistics, recruitment and retention.

Colorado MESA understands the importance of our advisors and values your impact on students and the success of our program. Your continued dedication and support is the foundation of the MESA program.

Mission

Colorado MESA is a nonprofit 501(c)3 organization under the Colorado Minority Engineering Association (CMEA). Our Mathematics, Engineering, Science Achievement (MESA) program is designed to prepare underrepresented minority and female students for the rigors of a college/university education and a major in mathematics, engineering or science.

History

The Colorado Minority Engineering Association, Inc. (CMEA), was incorporated in 1979, and is recognized by the IRS as a 501(c)(3) organization. Since 1980, CMEA has continued its administration of the Colorado MESA program for elementary, middle and high school students. Starting with thirty students in three schools, the MESA program is now in over 150 schools and over 3,000 students statewide. The majority of the programs operate in schools along the Front Range, but MESA programs are also located in schools in the Four Corners, San Luis Valley and Grand Junction areas.

MESA Program

Concept

The MESA program is designed to prepare, motivate, and provide ethnic minority/underrepresented and economically disadvantaged students the necessary support systems and skills in math and science to ensure successful participation and graduation from a college/university. We partner with teachers, school districts, universities/colleges, administrators and industry representatives to provide a proven academic enrichment program for K-12 students around the state. To accomplish this objective, the program has minimum requirements that incorporate:

- Student Involvement
- Parental/Guardian Support
- Science, Technology, Math and Engineering (STEM) Based Project Activities
- Industry Involvement/Presenters
- Field Trips to College/University Campuses and Business/Industry/Government Institutions
- MESA Day Design Challenges
- Advisor (teacher) Professional Development Training
- Career and College Exploration including Scholarship Opportunities
- Summer Enrichment Camps
- University Mentors

Components

There are six basic components to the MESA program, all designed to increase student commitment to careers in mathematics, science, engineering and related fields.

1. *High School Academic Counseling*

Academic counseling is required for MESA students in the selection of their high school course work. You should review each MESA students' individual curriculum choices to assure that the selected courses will provide them the required four years of college preparatory Math, English, and Science. You should ensure that students understand that attaining a high level of academic performance (B grade or above) will enhance their chances for admission to a college/university and make them more competitive for scholarships.

2. *College and Career Counseling*

College pre-counseling for MESA students begins in their freshman year of high school. An excellent way to begin the process is to invite a university admissions counselor as guest speaker to outline college entrance requirements, emphasizing increased requirements to be accepted into engineering and related colleges.

You should provide special counseling for college entrance preparation and guidance in career selection. This is in addition to the counseling normally provided by the schools. You should meet with all MESA students at least two (2) times per year for a group discussion with local college/university counselors, admission and financial aid officers. Information covered should include academic requirements, entrance testing standards, financial aid application, and submission dates/forms. In addition, you should meet with MESA students on a personal, one-on-one basis in order to understand and provide support and guidance for individual needs and goals.

As advisors, you should ensure the students have the opportunity for a college/university visit (parent/guardian participation is encouraged). Schedule at least three (3) meetings per semester and ensure a local professional minority engineer/scientist/manager is available to speak about his/her career and to answer student questions (parent/guardian invitations are encouraged). Please seek assistance, if needed, from the MESA District Director or the Statewide MESA Office. We also plan to include additional information on speakers on the MESA web site at www.cmesa.org.

3. *Academic Tutorials*

Many students do not have the necessary background and academic experiences necessary to cope with advanced core courses. As advisors, you can help develop weekly tutoring programs to assist MESA students in acquiring the needed math, science, and English skills. Tutoring sessions can be scheduled at convenient times throughout the school day and/or after school. Tutoring can be provided by: advanced MESA students, college/university mentors, professional engineers/scientists, and community volunteers.

4. *Field Trips*

You should provide actual contact with individuals working in engineering, mathematics, and science related fields through field trips to research centers, universities, and engineering companies. This direct contact should give the students an awareness of the kinds of professions they may choose to enter and an opportunity to talk directly with successful role model minority engineers, scientists and managers in their work environments. Here again your District Director or State MESA Office may offer assistance.

5. *University Mentor Program*

Our university mentor program provides an opportunity for MESA students and advisors to interact with mentors (university students, retired engineers and engineering professionals) in the field of mathematics, engineering, science and technology. Mentors provide leadership skills and serve as a role model for students, assist you with administering activities and developing projects for the local/statewide/national competitions.

Please note that university mentors are currently available in the Denver Metro. For areas outside the Denver Metro, please contact the MESA statewide office for more

information.

6. *Summer Enrichment and Training Opportunities*

Summer offers opportunities for further development of career option awareness as well as financial assistance for high school MESA students. You may contact local business and industry to conduct a "Job Fair" in their school or district. Local youth employment agencies should also participate and MESA advisors should ensure students complete a resume and are counseled on job interview techniques.

MESA students should be aware of special Summer Enrichment Programs provided by universities. Examples are "Frontiers of Science" at UNC, SUMMIT and Prep SUMMIT at the Colorado School of Mines, the Engineering Honors Program and "Success Institute" at CU-Boulder, and the "Making of an Engineer" at the University of Denver.

Minimum Program Requirements

- Regularly scheduled weekly MESA meetings.
- Host at least one (1) parent orientation/activity meeting per semester.
- Student Tutoring Program
- Visit at least (1) college or university per academic year.
- Host a minimum of three (3) guest speakers per semester from University, Business or Industry with a focus one career exploration.
- One "New MESA Member" recruiting activity per semester.
- One individual student/advisor counseling session per semester.
- Students must have a 3.0 (B) minimum GPA in the combined Math, Science, English curriculum with a minimum C grade in all other individual courses.
- All high school seniors and juniors enroll and complete the A.C.T/S.A.T standardized tests.
- All high school juniors participating in the P.S.A.T or P.A.C.T. (if funds are available).

High School Curriculum Schedule

Course Description	9th Grade	10th Grade	11th Grade	12th Grade	Total
	Freshman	Sophomore	Junior	Senior	
Math	Algebra I & II	Geometry I & II	Algebra III & IV	Trigonometry Pre-Calculus	4 Years/Units
Science	Biology	Chemistry	Physics	College Biology, Chemistry or Physics	4 Years/Units
English	4 Years/Units of High School English (English Composition, Writing, etc)				4 Years/Units
Social Studies	4 Years/Units of High School Social Studies (History, Government, Civics, Geography, etc)				4 Years/Units
Foreign Language	2 Years/Units of High School Social Studies (History, Government, Civics, Geography, etc)				2 Years/Units
Electives	Academic Electives (AutoCAD, Computer Graphics, Programming, Labs, etc)				

MESA advisors must monitor student class schedules on a regular basis to verify the above requirements are met and that the student successfully completes the course with a passing grade.

The MESA High School Curriculum Schedule meets the 2008 and 2010 Colorado Commission on Higher Education admission requirements for any Colorado public four-year institution. For more information, please visit

http://www.cmesa.org/documents/handbook/admission_standards.pdf

Program Demographics

The primary target audience for Colorado MESA is historically underrepresented (African American, Native American, Hispanic/Latino and Women) and economically disadvantaged students. The demographics for a school's MESA program should equal 60% minority or be reflective of the school demographics, whichever is higher.

One of Colorado MESA's objectives is to ensure that all our schools strive to reach the program demographics with the assistance of the statewide office. Our staff will work with you as an advisor to assist in these efforts.

MESA Meetings

Student MESA Meetings

Determine the weekly meeting time and location for students. A typical meeting may include the following agenda items:

1. Introduction of Guest Speaker (if applicable)
2. Team Building Activity
3. Attendance and Announcements
4. Administrative Business (forms due, academic status reports, etc)
5. Committee Reports
6. Activity (guest speaker, projects, competition, etc.)
7. Activity Summary and Evaluation
8. Next Meeting/Activity (time/date/location)

Parent Meetings

At least one (1) parent orientation/activity meeting per semester is **required**. The statewide office will gladly assist you in organizing and facilitated your parent meetings.

The parent meeting will familiarize parents with the goals and objectives of the MESA program. They will learn about the support systems offered by MESA and, hopefully, they will become aware of the role they might play in strengthening the system. A typical parent meeting may include the following agenda items:

1. Program Goals, Objectives Overview
2. Membership Requirements
3. MESA Program Year Planned Activities
4. Parent Involvement Methods
5. Activity (guest speaker on Financial Aid, College Admissions, hands on activity, career exploration, Industry Guest Speaker, etc)
6. Organize a Parent Support Group
7. Parent Networking Opportunities

Some MESA advisors with the cooperation and assistance of their District MESA Coordinator, organize a district wide parent meeting. Often the meeting includes a pot luck dinner or a dinner prepared by the cafeteria staff. If the resources are available, the parent meeting may include a career fair in which representatives of the business and industry community as well as colleges and universities are invited to set up their display for parents and students.

District Advisor Meetings (if applicable)

Attend all scheduled district advisor meetings. Please refer to the calendar of events for detailed description.

Advisor(s) Role and Responsibilities

The MESA advisor plays a crucial role in administering the MESA program at the school. The advisor is the day-to-day in-school contact for the MESA program and is responsible for administering the program on a regular basis.

If possible, we encourage advisors to find at least one other co-advisor to assist in implementing the MESA program. A co-advisor alleviates the sole responsibility of one person to administer the program

Administrative

- Recruit a minimum of 20 students
- Maintain submit student records to the statewide MESA office. Records include:
 - Student Enrollment Form
 - Parent Survey Form
 - MESA Advisor Information Form
 - MESA Advisor Semester Report (Fall and Spring)
 - High School Senior Information
 - Parent Permission Form
- Provides on-site supervision of the MESA program
- Reviews students academic performance to ensure compliance with the MESA requirements
- Nominate students for the “Outstanding MESA Student Award”
- Provide on-going recommendations for improvements and needs for the MESA program to the statewide office

Coordination

- Coordinate guest speakers, STEM based hands-on activities and events
- Provide student with information about STEM based career fields
- Host guest speakers on-site
- Encourage and active parent involvement
- Present information on scholarships, mentoring programs, summer enrichment camps and other related activities to the students and parents.
- Promote and encourage students to apply for the MESA annual scholarships (Charlie Farrel and Robert Rodriguez)
- Maintain an open dialog with your school principal on the MESA program, including updates and success stories
- Attend the district advisor meetings (if applicable)

Activities

- *MESA Design and Engineering Challenges*
 - High School Engineering and Science Challenge

- Middle School MESA Day Challenge
- High School Fall Fling
- MESA USA National Engineering Competition

Colorado MESA engineering challenges provide students, parents, advisors and supporters with a series of hands-on, engineering, science and mathematics related competitions, exhibits and presentations. At each of the engineering challenges, students have the opportunity to demonstrate their skill, knowledge, and creativity in the fields of science, mathematics, engineering, teamwork and communication as a result of participating in the Colorado MESA program over the past year(s). At the H.S Fall Fling and M.S MESA Day, winning MESA teams qualify for the opportunity to compete in the MESA USA national competition.

- *MESA Advisor Retreat and Kick-Off Professional Development Event - MARK*

The MARK professional development event kicks-off the new academic year for Colorado MESA. MARK provides a series of workshops, trainings, presentations and networking opportunities for all Colorado MESA advisors. Through MARK, you will learn new teaching and motivational strategies; receive academic enrichment materials and information; increase their awareness of mathematics, science, engineering, and technology related careers and the academic preparation required for entering STEM related fields; network and exchange ideas with colleagues; and interacts with university, industry, and governmental agency members.

- *MESA Awards Banquet*

The annual MESA awards banquet is an opportunity to recognize the MESA program's accomplishments over the past year. The banquet highlights several outstanding students, programs and advisors from around the state and awards two scholarships to graduating seniors. In addition, the awards banquet allows our sponsors an opportunity to meet the students, advisors and coordinators and view first hand the impact of their funding and support.

Student Recruitment and Selection

Recruitment and retention of students is crucial to the success of the MESA program. It is important for MESA advisors to understand that many ethnic minority students respond differently to outreach and recruitment. Simply announcing the MESA meeting time and location is not a sufficient recruitment effort. Successful minority recruitment means that additional forms of outreach must be undertaken.

Recommended Recruitment Steps

Below are a few recommended steps to following when recruiting new students for the MESA program:

1. Acquire a listing of all prior “veteran” MESA students that are attending your school. Contact these MESA students at the beginning of each school year.
2. Request that the math and science faculty recommend students from their classes that meet the general MESA guidelines and who are from under represented minority groups as potential MESA students. Written invitations should be sent to the selected students followed by a phone call or a personal invitation. Your “veteran” MESA members can help with this recruitment effort.
3. Schedule a meeting with the MESA students at the beginning of the fall semester. Preferably within the first few weeks of the new semester.
 - The first meeting should develop plans for MESA student recruiting and schedule student officer elections. The program should focus on potential MESA students, with a recruiting strategy and a target date. The advisor may wish to also consider Associate MESA students (those with less than a 3.0 GPA, but with an interest in science, math and/or engineering).
 - The target date recruiting program should incorporate an outside business or industry speaker and a one semester agenda for program activities, projects, visitations and field trips. Returning students can help plan the agenda.
 - The first recruiting meeting should include handouts to MESA students and associate MESA student recruits inviting parents to attend a parent orientation meeting within two to four weeks.

Timeline

August	Enlist the assistance of the “veteran” MESA students and the math and science faculty to identify potential MESA students that meet the general requirements.
September	Organize the first MESA student meeting and select the meeting times and places for the remainder of the semester.

	Submit your Advisor Information Sheet to the statewide MESA office.
	Plan your MESA semester parent meeting.
October	Collect and submit the MESA Student Enrolment and Parent Permission Form to the statewide MESA office and district coordinators (if applicable).
November	Attend the Fall Fling (High Schools only)
December	Submit MESA Advisor Semester Report to the statewide MESA office.
February	Identify outstanding MESA students in your program and nominate them for the annual Outstanding MESA Student Award.
April	Attend the MESA Day or High School Engineering Jamboree
May	Attend the Annual Awards Banquet.

Student Officers

President

MESA students view this office as carrying a high degree of status and therefore should be reserved for a student with a respectable GPA and leadership skills. The duties of the President may include chairing regular student meetings and working closely with the MESA advisor in coordinating activities.

Vice President

The duties of the Vice President may include acting in the absence of the President, coordinating with activities and events with the MESA advisor and organizing committees for special events

Secretary/Treasurer

The duties of the Secretary and Treasure may include maintaining attendance of students at regular meetings, recording of returned forms, meeting minutes, organizing fundraising efforts, sending thank you letters and assisting other officers as necessary.

Parent Involvement

The parent involvement information is intended to provide parents with a foundation upon which they can build an informed and mutually beneficial relationship with the MESA program and advisor. No organization, person, activity or project can motivate and support your MESA students more than concerned parents. Parents are the backbone of our most successful MESA programs and building a supportive parent group for your MESA school is not difficult.

Academic Support

Parents can provide academic support for the MESA program in a number of ways including:

- Supervise tutoring/study sessions.
- Act as a tutor or resource for students.
- Provide car pools for field trips, event and tutoring/study sessions.
- Help write, print and distribute newsletters.

Parent In-Service

Parents can be involved in MESA activities that assist them in supervising the study habits of their children and in reinforcing MESA goals and objectives:

- Attend presentations on procedures for applying for admission to college, financial aid, and scholarships.
- Attend presentations on college survival skills.
- Attend presentations on the need for professionals in the math-based fields in the next century.
- Participate in training sessions that will equip them to conduct workshops for other parents.
- Attend workshops on how to select an appropriate college.
- Attend sessions that train parents to become speakers who tell the MESA story to community groups.

Parents can often relieve the MESA advisor or district director of some clerical duties if the procedures for such activities are clear and available.

- Call students to remind them of application deadlines.
- Call other parents inviting them to participate in activities sponsored by MESA.
- Organize guest speakers and field trips to colleges/universities and industries.
- Assist with the MESA newsletter.
- Organize fundraising activities that help to fund student awards and other educational activities.
- Assist in the execution of career awareness programs.
- Plan and present MESA family events.
- Plan and supervise social events for MESA students.

- Assist with the annual MESA Awards Banquet.

Parent Fundraising

Parents can sponsor social fundraising events such as:

- Candy and food sales
- Raffles
- MESA booths at Christmas and other fairs
- Dances/music/band festivals
- Obtain financial and in-kind contributions from civic, church and social organizations to which they belong

MESA Parent Question and Answer

Q. *What does MESA mean?*

A. MESA stands for Mathematics, Engineering, Science Achievement.

Q. *What is MESA's goal?*

A. The overall goal is to motivate, support and prepare MESA students to ensure their success in undergraduate programs at four-year universities with an emphasis on engineering, computer science and other mathematics or science based fields of study.

Q. *Does MESA work?*

A. Yes! More than 90% of MESA high school graduates go on to college, and of these more than two-thirds choose math-based majors.

Q. *Why was my child selected to participate in MESA?*

A. Your child was asked to participate in MESA because of her/his interest in math and science, intention to prepare for and attend college, and because your child meets criteria for educational need.

Q. *What can MESA do for my child?*

A. MESA offers study assistance, academic and career advising, field trips and guest speakers, recognition and scholarship incentive awards.

Q. *What will be my child's responsibility to MESA?*

A. Enroll in appropriate math, science, and English, college prep courses and the MESA class period, where offered.

- Attend regularly scheduled MESA meetings at school.
- Attend student tutoring/study sessions to receive help in maintaining high academic standards.
- Participate in field trips to companies, colleges/universities and industry sites.

MESA Awards and Scholarships

Outstanding MESA Student Award

The annual Outstanding MESA Student Award recognizes 15 outstanding MESA students from around the state. Out of more than 3,000 students, the 15 outstanding MESA students have shown exemplary leadership, creativity and commitment to MESA's mission. As an outstanding student award recipient, students receive a reconditioned **Pentium based PC computer** and recognition at Colorado MESA's annual awards banquet in May.

Eligibility

- Current MESA student.
- Attend the **18th Annual Awards Banquet** scheduled for May 2009. Students must be present at the awards banquet to receive honor.
- Submit a completed Outstanding Student Application. Forms can be downloaded from the MESA website at www.cmesa.org.

Selection

Selection criteria used by our panel to select the finalist will include: GPA, MESA participation, academic and other honors. It is beneficial to include any additional awards, honors, volunteer activities, work experience and/or other community involvement you would like the selection panel to consider.

MESA Scholarships

Robert Rodriguez and Charile Farel

The Colorado MESA scholarship fund for eligible high school students has been endowed with donations inspired by the memory of Mr. Robert Rodriguez and Mr. Charlie Farel, two extraordinary people who were long time supporters of Colorado MESA and diversity education. In order to be eligible for either scholarship, students must demonstrate financial need (1/2 the points are based on financial need), be a current MESA participant and submit a completed application by **March 31, 2009**.

Eligibility

- Official transcript of High School Courses completed;
- Personal Statement;
- Photocopy of page(s) from the Federal Student Aid Report (SAR) showing family Income;
- Photocopy of letter of acceptance into a college or university;
- Applicant certification of current membership in a Colorado MESA program;
- Applicant must be planning to major in one of the following disciplines: engineering, natural sciences, math or computer related field such as computer science or computer information systems (Technology);

- If awarded scholarship, recipient agrees to participate in the MESA Awards Luncheon, in May 2007.

Please note that by submitting a completed application by the deadline, you are eligible for both scholarships. All applications must be post marked no later than **Monday, March 31, 2009**.

MESA Science and Engineering Mini-Projects

Index Card Bridge

Objective

Using the fewest number of index cards possible, build a bridge that can sustain a minimum load of two 1/2-bricks. Materials to be used include 3x5 index cards, a maximum of one box of paper clips, a maximum of one roll of tape, and safety scissors. All materials will be provided. Dimensions of the bridge should be:

- 10” minimum span length
- 3” minimum width for decking
- 12” minimum total length



Rules

1. Bridge must be build on-site, but no time limit will exist.
2. There is no limit on the number of cards used, however, heavy penalties are levied for using more than 10 cards.
3. Loading will be done 1/2-brick at a time and will be placed at the center of span(s).
4. Maximum of three people per team, for safety.
5. Supports are to be excluded from the design.

Judging

Upon completion of the design and construction, all bridges are judged as follows:

- Twenty (20) points are given for each of the quarter-bricks that the bridge supports.
- Five (5) points are given for each of the remaining cards that the designer *does not* use.
- Ten (10) points are *deducted* for each additional card that the designer uses.

The designer who earns the most points wins. In case of a tie, bridges will be loaded until failure.

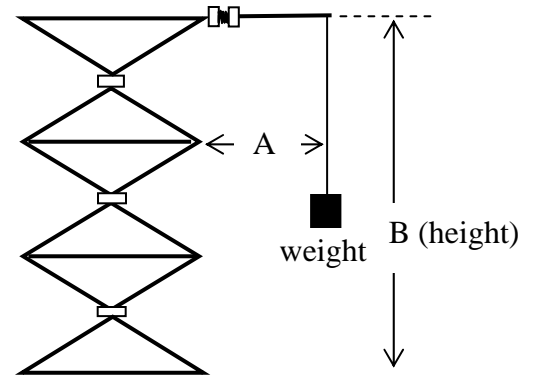
Model Crane

Objective

Construct a model crane type, structure using plastic drinking straws, tape, and string, which will support an off-center load of 100 grams.

Materials

- 30 inches of 3/4" masking tape
- 15 plastic drinking straws (3 flexible, 12 straight)
- 5 inches of string



Judging

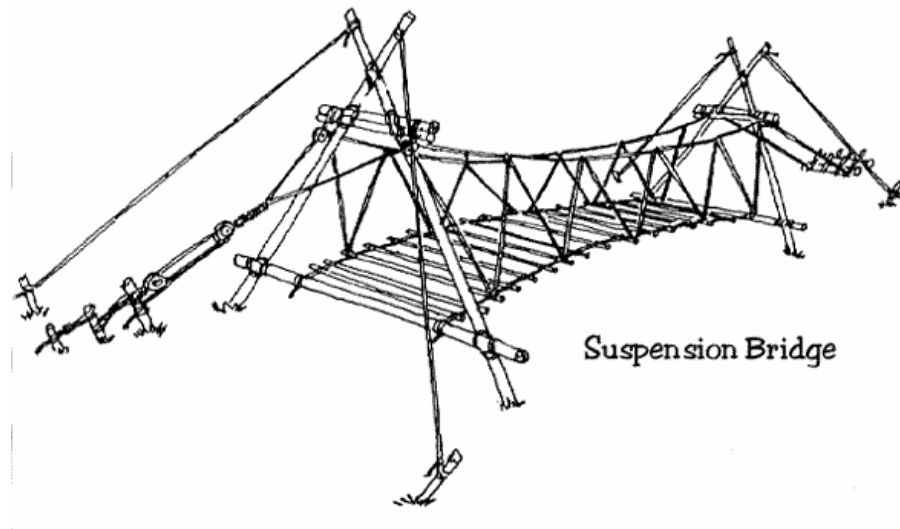
1. Using the string provided, you must provide a way for the judges to hang the 100 gram weight on the structure.
2. The Judges will keep time and no team member should touch the structure after time has been called.
3. Each team builds only one crane, but redesign and construction will be allowed during the time limit.
4. The crane must support the weight.

Each crane will be scored based on a combination of the horizontal distance from the base to the weight (A), and the vertical distance of the crane (B). The final score will be calculated using the equation: **SCORE = 5A + B** where A equals the horizontal distance from the base to the weight and B equals the height of the crane.

Newspaper Bridge

Objective

The objective is to construct a bridge from newspaper that supports a standard telephone book or other pre-determined weight.



Materials

- 10 complete copies of a standard newspaper edition (for example, the Denver Post or Rocky Mountain News Daily edition)
- 2 rolls of scotch tape

Rules

The bridge must be at least 2' long (between piers) and have at least 6" of clearance (see diagram above).

Judging

Bridges will be judged on appearance (50%) and their ability to support the phonebook (50%).

Pringle Mailing Challenge

Objective

The objective of this contest is to successfully mail one potato chip to a pre-set destination without it breaking. Once mailed and received, the packages will be opened to determine if the contents (potato chip) are in tack and have not broken.



Materials

- 1 mailing envelope and stamp
- 1 regular unaltered potato chip

Rules

- The mailed package must include one (1) regular unaltered potato chip.
- There no size specifications however remember those package weights will be compared to determine winner.
- Any non-hazardous or materials may be used. Please note that the contents of the envelop must meet the USPS mailing standards.

Judging

The winner is the lightest package received and completely in-tack potato chip.

Edible Car Challenge

Objective

Design and build a completely edible car.

Materials

Any edible (safe to eat) material(s).

Rules

- Every car must be edible.
- Cars must have a body, three or more wheels, and at least two axles.
- Cars must travel down an incline plane that is 42 inches long, 15 inches wide, and at a 30 degree angle.
- Car must measure no greater than 12" x 12" x 12".
- Only one entry per session per person is permitted.

Judging

The car that travels the farthest and meets all the above standards wins.



Mechanics Explained

Demo 1 – Does Shape Matter

Objective

Objective of is to determine if shape affects the strength of an object.

Materials

- 3 sheets of paper
- Cellophane tape (preferable), or regular scotch tape
- Light books, roughly 1 lb. (try to find 4-5 light paperbacks)

Procedure

1. Fold the paper sheets into three shapes by following these steps:
 - a. Shape A-fold one sheet in thirds and tape the edges together.
 - b. Shape B- fold one sheet into fourths and take the edges together.
 - c. Shape C- roll one sheet into a cylinder and tape the edges together.
2. Stand each paper shape on a flat table.
3. Place one book at a time on top of each shape until it collapses (here, I suggest starting with the square-based object followed with the triangular-based and, finally, the cylindrical objects)
4. Refer to attached the diagram.
5. Using a blackboard (if not available, take a sheet of poster board), record the number of books that each paper shape can support.
6. Remember that you'll have to create the shapes for each class that you teach since they become useless after crumpling.

Results

The rolled paper holds more books. It might be interesting, before starting the demo, to ask the kids to guess which object will hold more books. Chances are most kids will have mixed responses. Now, try to explain to them why?

Gravity (a pull toward the center of the earth) pulls each book downward, and the paper structures push upward. If the upward push is less than the downward pull of gravity, the book crushes the paper structure. The open paper cylinder is the strongest of the shapes tested because the weight (force of gravity) of the supported book (s) is evenly distributed through the paper pillar.

Demo 2 - Full of Air

Objective

To demonstrate how friction affects inertia using Newton's first law inertia, friction and force.

Materials

- 1 shoe box
- 10 round pens or drinking straws
- Scissors
- 1 balloon, approx. 9 in.

Procedure

1. Cut a hole, roughly 1/2 – 1 in. square, in the center of the end of a shoe box (I found that the shoe box should be as light as possible and just big enough for the balloon to fit in when fully inflated)
2. Line up 10-12 straws or thin round pens, spacing them an inch apart and parallel.
3. Lay the balloon inside the box with its mouth sticking out through the square hole in the end of the box.
4. Inflate the balloon and hold the mouth of the balloon shut between your fingers.
5. Now place the balloon/box apparatus on top of the pens or straws, making sure that the width of the box is parallel with the length of the pens/straws.
6. Release the balloon and jump around and hoot n'holler.

Results

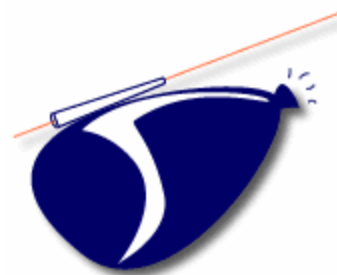
As the balloon deflates, the box moves forward. It continues to move for a short distance after the balloon deflates.

Newton's First Law of Motion states that an object will not change its motion unless an unbalanced force acts on it. Yes, this is a bit deep for the younger kids, but maybe your older (12.-13 year olds) kids can handle it. This resistance that an object has to having its motion changed is called inertia. The box stays where you put it unless it is pushed. The deflating balloon gives the box a forward push. (note: you might want to try a further demonstration by using a volunteer and having them give you a shove; definitely pick one of the well-behaved kids). This unbalance force starts the box moving, and it continues to move until a second force, friction, makes the box slow down and then stop. Friction is a force that pushes against a moving object, causing it to stop moving.

Demo 4 - Balloon Rocket Blast Off

Objective

Objective of Demo 3 is to demonstrate how unbalanced forces produce motion using Newton's law of action and reaction.



Materials

- Balloon (the balloon for this experiment should be the long, phallic one, not the round one used for the shoe box demo)
- Scissors
- String
- Masking tape

Procedures

1. Measure and cut a 4-in. piece from the straw.
2. Cut about 10 ft. (or however much you'll need to connect it to two stationary points in the classroom.) of string.
3. Thread the end of the string through the straw piece.
4. Tie the string to two stationary points (chairs work well!) and make sure that the string is relatively parallel to the floor and as tight as possible; a slack string will produce a demo dud.
5. Inflated the balloon and twist the open end.
6. Move the straw to one end of the string.
7. Tape the inflated balloon to the straw (see attached diagram)
8. Release the balloon.

Results

The straw with the attached balloon jets across the strings. The movement stops at the end of the string or when the balloon totally deflates. An alteration would be to try using two balloons, each of which is taped to the same straw. Kind of like having two engines in a plane.

Newton's Law of Action and Reaction states that when an object is pushed, it pushes back. When the balloon was opened, the walls of the balloon pushed the air out. When the balloon pushed against the air, the air pushed back and the balloon moved forward, dragging the straw with it. The string and straw keep the balloon rocked on a straight course. You can also discuss the concepts of potential and kinetic energy with your older kids while doing this demo, then use it as a transition to the Paddle Boat Activity.

Activity 1 – Helicopters!

Objective

To determine how weight affects the rotation speed of a paper helicopter. Concepts covered include weight, rotation, gravity and speed.



Materials

- Notebook paper
- Pencil
- Scissors
- 3 paper clips
- Ruler

Procedure

1. Fold and cut one sheet of paper in half lengthwise.
2. Fold one of the halves in half lengthwise.
3. Use a ruler to draw a triangle on one edge of the paper. The base will be 1 in. long and the side will be between the 4-in. and 6-in. marks on the ruler. See the attached diagram.
4. Cut out the triangle. Cut through both layers of the paper.
5. Open the paper and cut up the center fold to the point indicated on the diagram. This forms the two wings.
6. Note: you may want to have the kids color their ‘copters. This will provide a little more excitement, especially by coloring the tops of the wings in interesting designs. Also, coloring can provide filler time while other kids are using the scissors. (I’ll try to provide the sheets of paper with the diagram already drawn on it, which will make it easier for the kids to cut out).
7. Fold the tabs toward the center and attach a paper clip to the bottom.
8. Fold the wings in opposite directions.
9. Hold the helicopter above your head and drop it (maybe let your kids get up on their chairs to give the ‘copters a higher altitude to fall from)
10. Add different numbers of paper clips one at a time and drop the plane after each addition.
11. Also try twisting the wings in different directions to show how it affects the direction of rotation.

Results

The rotation speed increases as the weight (paper clips) increases, but a point is reached where additional weight pulls down with such force that the wings move upward and the plane falls like an falling object. Also, by twisting the wings in opposite directions, the helicopter will rotate in different directions.

As the paper falls, air rushes out from under the wings in all directions. The air hits against the body of the craft, causing it to rotate. Increasing the weight by adding paper clips causes the helicopter to fall faster, and the amount of air hitting the craft's body increases. This increase in air movement under the wings increases the rotation speed.

Activity 2- Building Paddle Boats

Objective

To demonstrate Newton's Law of Action and Reaction.

Material

- Cardboard
- Rubber band
- Scissors
- Container of water
- Ruler

Procedure

1. Measure and cut a 4-in. square from the cardboard (you may want to cut 5-in. squares and then have your kids cut them out of that piece; it may work best to create a 5-in stencil to make the cardboard allotment easier.)
2. Shape the boat by cutting one side into a point and cutting out a 2-in. square from the opposite end.
3. Cut a paddle from the cardboard. Make it 1 in. X 2 in. (make sure there is plenty of room for the paddle to fit back into the boat; it works best if you cut more off the boat after the paddle has been removed)
4. Like the Helicopter Activity, have them design the tops of their boats while they're waiting for scissors if you need filler time.
5. Loop the rubber band over the ends of the boat (it may help to put niches in the sides of the boat to hold the band better)
6. Insert the paddle between the sides of the rubber band.
7. Turn the cardboard paddle toward you to wind the rubber band.
8. Place the boat in the container of water and release the paddle.
9. Wind the rubber band in the opposite direction by turning the paddle away from you.
10. Place the boat in the water and release the paddle.
11. Depending on time, try setting up this activity so the water is divided into lanes. Now the kids can race against each other, but be careful about letting them get too worked up.

Results

The boat moves forward with the first trial and backward when the paddle is turned in the opposite direction. Be Careful, however, cause the cardboard can only survive maybe 4-5 runs before it gets too soggy and falls apart.

Newton's Law of Action and Reaction (refer to Rocket Demo). Winding the paddle caused it to turn and hit against the water. When the paddle pushed against the water, the water pushed back and the boat moved. The boat moved in the opposite direction to the paddle, changing direction when the paddle direction changed. If you think certain groups of your kids can handle it, try to explain potential and kinetic energy and how it applies to the rubber band.