
Introduction

THIS SPRING, the Creighton University Society of Physics Students (CUSPS) will again sponsor Physics Field Day, a day of activities and excitement for high school students. The day is filled with competitions that require understanding and application of basic physical principles. We in the CUSPS believe that physics can be enjoyed in a hands-on, competitive spirit. There is an event for everyone! The diversity of Physics Field Day events hopefully encourages many students to participate in a challenging event of their choice.

We at Creighton are proud to announce the completion of a new science building. We moved into the new building for the Spring 2003 semester. Participants in Field Day will be able to tour the new building and the rest of the Creighton campus. As part of the excitement for the new building, the theme for the 2004 Physics Field Day will be "The Physics of Buildings and Other Structures."

On the following pages are descriptions and a full set of rules for the events that we have chosen for this year's Field Day. Please read these rules carefully and prepare well for the flurry of events and excitement that make Field Day an educational, and more importantly, fun experience. If you have any questions regarding the rules or operation of any event, please e-mail cusps@creighton.edu or call 402.280.5559 or 402.280.2835 and leave a message for Jeff Sykora or Dr. Mike Nichols. We will also create a web page link from <http://physicsweb.creighton.edu/> regarding Field Day rules and suggestions.





Events:

Chalk Talk

Topic: The Physics of structures and buildings.

I.) Procedure:

Only one contestant per team. Each contestant is allowed to bring colored chalk and no more than two five-by-seven inch index cards with notes. No contestant will be allowed to sit in on other speakers' talks until the final round. Each speaker will present his/her talk to three judges and the room will be closed to all others at that time. The speakers will be given no more than five minutes to present the talk. The judges will give the speaker a warning at four minutes in order to let the speaker finish within the time limit.

After all the talks have been given, the top four participants will be selected to present in the final round of the Chalk Talks. The names of the four finalists will be announced just prior to the beginning of the final round. If a finalist is not present at the time of the announcement, his/her eligibility will be forfeited, and the next highest rated contestant will be selected.

II.) Judging:

A.) Delivery: In the delivery of the talk, the contestant should use smooth, concise English and maintain eye contact with the judges. A contestant's poise during his/her presentation is also part of the judging criteria.

B.) Content: During talk itself, the following will be considered:

1. The amount of material covered.
2. The logical flow of ideas.
3. The quality of material covered.
4. The creativity of the talk (originality).

C.) Questioning: After the talk the judges will take five minutes to ask the contestant relevant questions pertaining to the topic. The speaker's answers will be judged on the following criteria:

1. The accuracy of the answer.
2. The relevance of the answer to the question.
3. The ability to think about the questions in unfamiliar areas of the topic.

III.) Suggestions:

A.) The talk should concentrate on structures and building. Do not dwell on material not related to physics. In the presentation of your material, do not attempt to explain phenomena that are beyond your mathematical and physical comprehension. Know your ideas with as much depth as possible.

B.) In preparation for the question period, familiarize yourself with the basic physical principles that relate to structures and buildings.

C.) Possible talks might include the physics of a suspension bridge or the physics of buildings in California that are made to withstand earthquakes, or perhaps the physics of a dome.s

D.) Remember that the judges are trying to evaluate your speech fairly. They are not trying to exploit the speech or the speaker.





Leap Frog Exam

Purpose: This exam is used to test the subtle points of physics and the individual's ability to deal with difficult problems or complicated situations.

I.) Teams:

Each team will consist of two individuals.

II.) The Test:

The test consists of two parts, A and B. Each team member will be given a different part. After 20 minutes, the two team members will be able to confer about the test for 5 minutes. Neither member may leave the room or discuss the test with anyone but their partner. After the 5 minutes the team members will switch parts of the exams and will given 25 minutes to finish the test. No time to confer with team members will be given during or after the second half of the test.

III.) Equipment:

Students may not bring anything into the exam except a pen, pencil, and calculator. Programmable calculators may be used, but their memory will be erased at the start of the exam. Papers, books, or notes are not permitted.

IV.) Scoring:

There will be no penalty for wrong answers. Each question will be multiple choice with five possible answers. The highest number of correct answers will win. In case of a tie, a back up test of five questions will decide the tie-breaker.

V.) General Information:

Commonly used formulas and constants will be given on the front of each exam. Proper use of these formulas should enable the team members to solve all of the problems on the exam. You may write on the exam or mark certain questions for your partner, but at the end of the examination period, all tests will be collected. Only answers on the answer sheet will be accepted.

Optical Slalom

Purpose: Using the principles of geometric optics, participants will maneuver a beam of light to hit a specified target by reflecting the beam off and through a series of optical elements.

I.) Team:

Each team will consist of two members.

II.) Rules:

A.) Each team will aim the beam blindly (with the laser shutter closed) except for three optional wild card shots of 5 seconds in duration.

B.) Once the team has signified that they are satisfied with the placement of all the optical devices, the shutter is opened for scoring. At that time no optical elements may be moved, added, or subtracted.

C.) Contestants are allowed to choose any appropriate path for the beam.





D.) The path of the beam must be continuous. It must avoid touching anything other than optical elements. Support structures for apertures and previously positioned optical elements are considered immovable obstructions and must be maneuvered around.

E.) The beam may strike any part of the optical element.

F.) There will be a time limit in which to hit the target. Be ready to start on time!

III.) Equipment:

Teams may bring in relevant texts, tables, calculators and pencils. Optical elements (lasers, mirrors, and prisms), meter sticks, protractors, and scratch paper will be provided. Contestants must bring all other equipment they deem necessary.

IV.) Scoring:

Scoring will be based upon how many optical elements are successfully used as well as the radial distance from the beam to the center of the target.

V.) General Information:

The room will be closed to all spectators during the competition. In all cases of rule interpretation, the decision of the judges is final.

Egg Catch

Purpose: To design and construct, prior to Field Day, a device, which will catch a fresh, uncooked, Grade A large chicken egg and prevent breakage after being dropped from different heights to a smooth surface below.

I.) Team:

Each team may consist of three people, and only one entry per team will be allowed.

II.) Judging:

A.) Devices will be tested at multiple heights.

B.) The egg will be dropped straight down by a member of the team. Each team will have two tries per height to hit the device.

C.) Each device will be tested from increasing heights until it does not safely catch the egg.

D.) If the egg is broken upon impact the device is considered to have failed and no points for the drop will be given. All eggs will be provided and will be broken immediately after each drop.

E.) Overall size requirements: The device must be a maximum 1 meter wide by 1 meter long by 60 centimeters tall.

III.) Scoring:

Points will be awarded for each height at which the egg is dropped and does not break. Significant bonus points will be awarded for each centimeter that a device is below the maximum height





requirement (granted the egg survives at least the minimum drop). Creativity of the design will be evaluated by the judges and may be used in the event of a tie.

Catapult

Purpose: To build, prior to Field Day, a catapult to fling raw Grade A large chicken eggs at targets a distance 25 and 50 meters away.

I.) Team:

Each team may consist of up to three people, and there is only one entry per team.

II.) Rules:

A.) Construction:

The catapult may be any size, built of any material, and operate on any principle, with two exceptions:

1. Students may not incorporate anything sold commercially as a catapult (i.e. no Nerf launchers or hunting bows).
2. No explosive devices of any kind.

B.) Competition:

1. The catapult will be fired from behind a line to targets of 25 and 50 meters away. The entire catapult must be behind the line before and after the launch.
2. Each device will have two trials at each distance. There will be a reasonable amount of time given to reset the catapult. Modifications of the device will be allowed for each distance.

3. Eggs will be provided

III.) Scoring:

The scoring will be the sum of the radial distance from the targets on the better of the two tries. Creativity of design will break any ties.

IV.) Suggestions:

In developing this event, we had luck with “slingshot” models using surgical tubing, with the traditional model consisting of a flexible arm that is tied back and released suddenly.

Bridge Building

Purpose: Using the principles of static mechanics the contestants are to design and construct a bridge of toothpicks and glue prior to Field Day. On the day of competition, each bridge will be tested for strength and design according to the rules.

I.) Teams:

Teams may consist of up to two people, and only one entry is allowed per team.

II.) Construction:

A.) Construction Materials:

Bridges may only be constructed of;

1. Wooden, flat toothpicks of the variety sold in grocery stores (no homemade toothpicks).
2. Elmers Glue-All, for porous materials (white, water soluble glue). No other adhesive of any kind is allowed.





3. No thread, staples, wire, or any other type of reinforcement is allowed.

B.) Dimensions of the Bridge:

1. The bridge must be between 60 and 80 centimeters long and between 4.6 and 19.5 centimeters wide.
2. A continuous level roadway of toothpicks with no gaps must be completed. The roadway must lie in a horizontal plane. It may not deviate, at any point, more than 1 centimeter above or below the horizontal plane connecting the two ends of the bridge.
3. The total mass of the bridge, including glue, cannot exceed 125 grams.
4. The bridge may not have any supports extending below the roadway.

III.) Judging:

A.) The bridge must be able to hold at minimum 4 kilograms (the mass of the testing apparatus).

B.) The bridge will be placed upon a rigid framework (as seen in diagram 1).

C.) The bridge must rest upon the surface of the supports and will not be affixed to the support structure in any way.

D.) The standard testing frame (see diagram 2) shall be placed on the roadway surface over the center of the span with either one or two 1/2" diameter rods extending beyond the side of the bridge. The load applied to the bridge shall be suspended from either the single rod placed in slot A of the test frame or the or the two rods

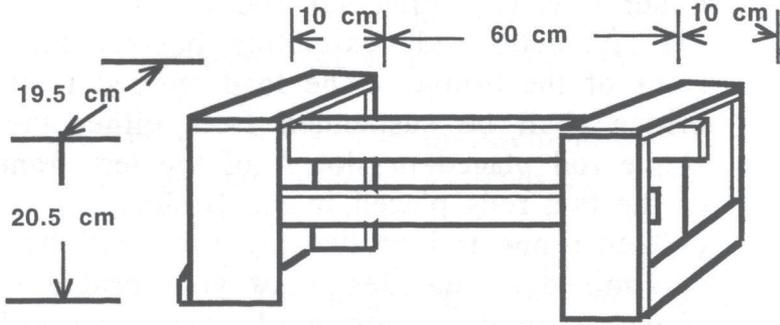


Diagram 1: Bridge Framework for Testing.

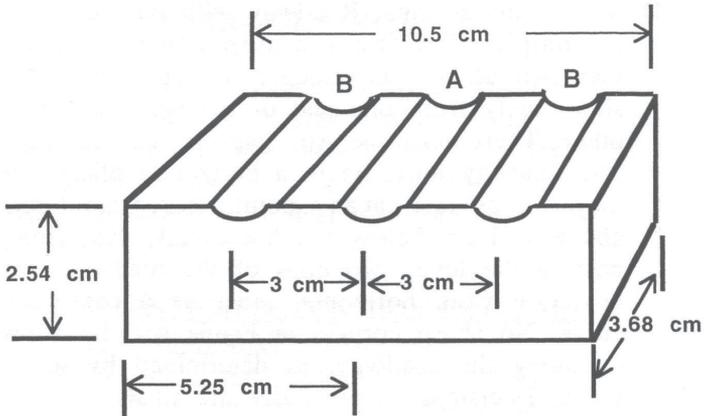


Diagram 2: Standard Testing Frame.





placed in the B slots. (The method used will depend on the design of the bridge. If either option works, the two rod method will be used.)

IV.) Scoring

A.) Sand will slowly be added to the suspended bucket hanging from the rod/s until one of the following occurs:

1. The structure collapses
2. The bridge sags or flexes more than 3 centimeters.
3. The bridge leans or tips such that the sand bucket is lowered more than 3 centimeters.
4. The bridge falls from the support structure.
5. In the opinion of the judges, the bridge has failed.

B.) The successfully suspended mass will be measured as well as the mass of the bridge.

C.) Bridges will be ranked by the in order of the supported mass to bridges mass ratio.

D.) The judges will disassemble every bridge into at least 2 pieces in order to verify compliance with the rules.

E.) In the event that more than one bridge does not fail under the maximum testing weight available to the judges, the lightest bridge would break the tie.

Student Powered Water Heater

Purpose: Each team shall construct a device prior to Field Day that will hold and heat 1 liter of water.

I.) Team:

Each team may consist of up to two people, and only one entry per team is allowed.

II.) Rules:

A.) Only human body energy supplied by the two students will be the source of energy. This energy can be changed into other forms in order to heat the water. No heat pumps are allowed.

B.) No combustible materials or solar energy may be used.

C.) The test water will be tap water at room temperature and will be measured the judges in an insulated container.

III.) Scoring:

A.) The test water will be poured into the teams container and they will have 5 minutes to heat the water. At the end of 5 minutes the water will be returned to an insulated container, and the temperature will be measured.

B.) If more than 50 milliliters of water was lost during competition, all the lost water will be replaced by tap water.

C.) The thermometer will be immediately inserted into the insulated container, and the temperature will be measured after stirring to ensure a homogeneous temperature.





D.) The highest temperature measured will be recorded. The winner will be the team that raises the temperature the of the water the most in 5 minutes, or the team that heats the water to 100° Centigrade in the fastest amount of time.

Paper Airplane Contest

Purpose: This event allows the teachers to participate in Field Day. They are to design and construct an airplane that will stay aloft for the longest period of time.

I.) Team:

Each school can have one teacher per team. If a school has two teams and one teacher, his/her score will be used for both teams.

II.) Construction:

A.) The planes may not have a mass greater than 20 grams.

B.) No Balsa wood or other paper supports are allowed with the exception of paper clips.

C.) No type of tape or glue is allowed.

III.) Judging:

A.) Each plane will have two trials. Time will be measured from the moment of release to the time of impact, and the longest trial will be used.

B.) Planes are considered down when they hit the ground, a chair, or a person (if it hits the wall it is not considered down).

C.) Any helicopter or Frisbee devices will be disqualified.

Demonstrations

An extra 5 points will be awarded to the team of any student who brings a demonstration. Any demonstration relating to physics is acceptable. Please notify us in advance if special equipment is needed, and we will try to provide it. Only one demonstration per team.





Registration:

CUSPS 31st Annual Physics Field Day

21.March.2004

8.00AM - 3.00PM

Cost: The registration fee is \$15 per team plus \$3 per person. Breakfast and lunch will be provided for both teachers and students.

To register, please email the following information to cusps@creighton.edu:

1. School Name
2. Advisor's Name
3. Number of Teams
4. Names of students in each event for each team

You may also mail the information to:

Field Day
Department of Physics
Creighton University
Omaha, NE 68178

or fax it to 402.280.2140

Please register by 6.March.2004. A late registration fee of \$5 will be apply to any registrations after that date.