PHILIPPINE SOCIETY OF YOUTH SCIENCE CLUBS
NATIONAL SCIENCE CLUB MONTH 2012

Theme:

Scientricity: Energizing Science Clubbers for Sustainable Energy

Mathematics, Science at Kalikasan 2012

Event Description and Project Guidelines

September 22, 2012

Contents

I. MathSciAKa Overview and Event Description

Mathematics, Science at Kalikasan
MathSciAKa

In line with the celebration of the Science Clubbing Movement, the PSYSC offers another venue for strengthening its main thrust in upholding the public understanding of science, technology, and the environment (PUSTE) especially to the young minds – the *Mathematics, Science at Kalikasan* commonly dubbed as *MathSciAKa.*

MathSciAKa is a free of charge, Luzon-wide activity which caters to all elementary and high school science clubbers within the region. For several years, it has provided a venue to challenge our science clubbers mentally and physically through fun and educational science workshops and activities. Also, it has provided a healthy Engineering Science competition between science clubs, besting each other in the different challenges.

This year, MathSciAKa, together with the whole National Science Clubs Month (NSCM) celebration, breaks the conventions of the usual science clubbing experience. MathSciAKa revolutionize itself, becoming more relevant to the prevalent issues of science, technology and the environment today. Not only would it provide a series of workshops, but it will present practical applications and theories in the concepts of **Sustainable Energy**. Also, new Engineering Science Challenges will be offered this year to tackle some concerns about energy and its effect to the environment and society.

MathSciAKa is now composed of four activities: the **Take Home Workshops**, the **On-the-Spot Workshops**, the **Interactive Workshops**, and the latest **Mystery Workshop**. Furthermore, it has two brackets: **Bracket I** for Elementary and **Bracket II** for High School. A school may send a maximum of **five (5)** students per bracket. Three of which will be for the On-the-Spot and Interactive Workshops and two of which will be for the Take Home Workshops and Mystery Challenge. The performances in these four activities will determine the **Over-all Champion**. However, participation to each activity is optional. Several prizes, medals, and certificates are at stake during the event.

The PSYSC has always believed that the youth holds the power to expand our frontiers. We continue to innovate. We continue to look for means to break the walls that limit us. We continue to change, revolutionize and find ways. These passions of innovation and novelty must be ignited in our young minds. Thus, we greatly appreciate your interest in accepting the challenges. We hope this guide sheet will provide you all the necessary information that you will need for the competition. If you have any inquiries, please do not hesitate to contact us through any medium mentioned below.

Kudos to our Future Scientist and Engineers!

The MathSciAKa 2012 Core Committee

*II. Schedule of Activities**

Venue: -To be announced-

What-to-bring: Come in your school's P.E. uniform and rubber shoes. Jogging pants and white shirts will do. Bring extra set of P.E. uniform, your school ID, towels, bottled water, packed lunch and umbrella.

Program

<table>
<tr><th>Time</th><th>Bracket I – Elementary</th><th>Bracket II – High School</th></tr>
<tr><td>7:00 AM – 8:30 AM</td><td colspan="2">• Registration Proper
• Preliminary judging for Take Home Workshops</td></tr>
<tr><td>8:30 AM – 9:30 AM</td><td colspan="2">Opening Program</td></tr>
<tr><td>9:30 AM – 12:00 PM</td><td>• On-the-Spot Workshops
• Judging Proper of Take Workshops</td><td>• Interactive Workshops
• Mystery Workshops</td></tr>
<tr><td>12:00 PM – 1:30 PM</td><td colspan="2">Lunch Break</td></tr>
<tr><td>1:30 PM – 4:00 PM</td><td>• Interactive Workshops
• Mystery Workshops</td><td>• On-the-Spot Workshops
• Judging Proper of Take Workshops</td></tr>
<tr><td>4:00 PM – 5:00 PM</td><td colspan="2">Sessions</td></tr>
<tr><td>5:00 PM – 6:00 PM</td><td colspan="2">Awarding and Closing Program</td></tr>
</table>

* The above schedule may change without prior notice. With this regard, always check www.psysc.org for further details.

III. General Guidelines

A. Interactive Workshops

The Interactive Workshops will be a set of different scientific games and puzzles to feed the interests of the young minds. It basically is a fun and exciting segment during the event, with the application of the learning in the different fields of science such as mathematics, biology, chemistry, physics, and general science.

Guidelines for Interactive Workshops:

1. The competition is open to all high school and elementary science clubs affiliates.
2. Each bracket will have at least ten (10) stations. Each station is worth 100 points and shall correspond to one activity or workshop.
3. Each participating Science Club can send only one competing team which will be composed of **three (3)** students.
4. The participants who will join the Interactive Workshops **will automatically join** the On-the-Spot Workshops.
5. The team shall only proceed to the next station upon the signal to move, whether the team has finished early in a station. The time taken in finishing the activity in the station shall be noted by the proctor.
6. The criteria for winning the Interactive Workshop will be based only on the accumulated points awarded in the stations. In case of a tie, the time factor comes in.
7. Specific guidelines for each station will be given at the event proper by MathSciAKa staff and station managers.

B. On-the-Spot Workshops

The On-the-Spot Workshops will contain series of experiments and workshops related solely to energy conservation and its concept's applications. The Science Clubbers will be involved in the different fundamental ideas and applications of the different fields of energy.

Guidelines for the On-the-Spot Workshops:

1. The competition is open to all high school and elementary science clubs affiliates.
2. Each bracket will have three (3) different workshops or experiments.
3. Each participating Science Club can send only one competing team which will be composed of **three (3)** students.
4. The science club members who will join the On-the-Spot Workshops **will automatically join** the Interactive Workshops.
5. The science club members who will join the Interactive and On-the-Spot Workshops **will not be able to join** the Take Home Workshops and Mystery Workshops.
6. The workshops and experiments shall be done simultaneously during the event proper and within the provided time.

7. Each workshop or experiment shall have its own station. All participating teams will be randomly assigned among the stations. The team will proceed to their next station upon reaching the time limit. Each team will work independently.
8. The specific guidelines for the workshops and experiments will be given during the event proper.
9. The criteria for winning the Interactive Workshop will be based only on the accumulated points awarded in the stations. In case of a tie, the time factor comes in.

C. Mystery Workshops

This year, MathSciAKa brings another category to the event proper: the Mystery Workshops. This part of the competition will be composed of impromptu challenges that may range from simple essay writing and slogan making to experiment designing and science journalism. To become a true scientist, one does not simply perform the experiment; one must also be open-minded and be engaged in critical thinking about present issues, towards of communicating the findings. The Mystery Workshops provide another venue for attaining the fullness of being a scientist.

Guidelines for the Mystery Workshops

1. The competition is open to all high school and elementary science club affiliates.
2. Each bracket will have one challenge. The challenge for Bracket I will be different from that of Bracket II.
3. Each participating Science Club can send only one competing team be composed of **two (2)** bona fide students.
4. Participants of the Take Home Workshops are **the same students qualified** to join Mystery Workshops. However, if a science club has no entry for the Take Home Workshops, they may opt to send **two (2) students** to compete only in the Mystery Workshops.
5. Participants who will join the Take Home Workshops and Mystery Challenge **will not be able to join** the Interactive and On-the-Spot Workshops.
6. The challenge and specific guidelines shall be given during the event proper.
7. Participants shall bring their own materials for the workshop. Failure to do so would disqualify them from participating
    - For Bracket I, bring art materials.
    - For Bracket II, research on sustainability of Nuclear Energy and Bataan Nuclear Power Plant
8. Each participating team will work independently.
9. The criteria for winning the Mystery Challenge will be based only on the scores awarded by the staff and judges. In case of a tie, a determining factor will be decided on the specific guidelines.
10. Specific guidelines will be given during the event proper.
11. The judges will follow the criteria set forth. The decision of the judges and staff is final and irrevocable.

D. Take Home Workshops

The Take Home Workshops will be composed of the new Engineering Science Challenges. Each bracket will have two different challenges. The participants shall design the project in their respective schools and shall be tested during the event proper. The participating science clubs will try to best each other according to the criteria and to the judges' decision. The Take Home Projects provide a venue for the creative and innovative practical application of scientific concepts.

Bracket I (Elementary):
Organic Battery
Rubber Band-powered Car

Bracket II (High School):
Parabolic Reflector
Copper (I) Oxide Solar Panel

Guidelines for the Take Home Projects

1. The competition is open to all high school and elementary science clubs affiliates.
2. Each school must have only one Science Club as the official participant to the MathSciAKa 2012. The Science Club may opt to join all the challenges.
3. A pre-judging of the projects will be done prior to the testing proper. Pre-judging involves inspection of the materials, dimensions and other specifications. Projects that did not qualify the pre-judging are allowed to modify their project until 8:30 AM. Beyond the time limit, projects that did not qualify the pre-judging are not allowed to proceed to testing proper.
4. The take home projects may be made by the entire Science Club; however, only **two (2)** science club members are to represent the entire Science Club during the judging on the event proper.
5. Together with the official project entry, hard copy documentations **must also be submitted** per Science Club. These documentations will contain the **documentaries** such as pictures with captions, and explanations as proof that the students created their projects. Consultations done for the project must be included in the documentary. The documentation is at maximum of five (5) letter sized pages.
6. During the event proper, participants are obliged to do the transport of their project. The MathSciAKa staff will not handle any of the projects and are not responsible for any damage.
7. The participants who will join the Take Home Workshops **will automatically join** the Mystery Workshops.
8. The science club members who will join the Take Home Workshops and Mystery Workshops **will not be able to join** the Interactive and On-the-Spot Workshops.
9. Rules, mechanics and specific guidelines of each project are included with this document. It will also be available www.psysc.org at different web portals of PSYSC.

Blogspot: www.ecatalyst.blogspot.com
Facebook: www.facebook.com/psysc
www.facebook.com/psysc.nscm
Multiply: www.psysc.multiply.com

10. The MathSciAKa Team will be strict to the specifications per Take Home Project.
11. Judges will evaluate the criteria during the judging. The decision of the judges and staff is final and irrevocable.
12. Pre-registration forms may be sent to the PSYSC National office through facsimile or through snail mail. Registration forms must be received by the MathSciAKa Secretariat on or before **August 24, 2012**.

IV. Over-all Scoring

Interactive Workshops	20%
On-the-Spot Workshops	30%
Take Home Workshops	30%
Mystery Workshops	20%
OVERALL	100%

V. Awards and Prizes

Php 25,000 worth of prizes will be given away

Over-all Champion
Trophy for the club, medals and certificates of recognition for all team members, 50% discount for the 2012 CSIW or 2013 NYSTESC for all team members and coach

First Runner Up
Trophy for the club, medals and certificates of recognition for all team members
Certificate for coach

Second Runner Up
Trophy for the club, medals and certificates of recognition for all team members
Certificate for coach

Interactive, On-the-Spot and Mystery Workshops
Will have first, second and third placers
Medals and certificates of recognition for all winning participants

Take Home Workshops
First Place
Php 2000 cash, medals and certificates for the representatives, certificate of recognition for the science club.

Second Place and Third Place
Medals and certificates for the representatives, certificate of recognition for the science club.

All participants (students and coaches) will receive Certificates of Appearance and Participation

VI. Summit MathSciAKa

MathSciAKa aims to explore the creativity and innovativeness of every student in the country. PSYSC provides another venue for students studying outside Luzon in developing their interest in Science through *Summit-MathSciAKa.*

Summit-MathSciAKa is an event during Summit where participants are challenged mentally and physically through fun and educational science workshops which are relevant to some issues in science and technology today. It is composed of two parts: Summit-Engineering Science and Summit-Interactive, the Summit counterparts of Take Home Workshops and Interactive Workshops, respectively.

Summit-MathSciAKa is an interschool competition during Summit. The top scorer in the Summit Engineering Science and Summit Interactive will be awarded. The total scores earned by each Summit-participating School in all Summit-MathSciAKa activities will determine the Summit-MathSciAKa Champion in the site.

A. Summit Engineering Science Challenge

1. This is open to all Summit-participating Science Club.
2. Each participating Science Club can send only one competing team.
3. A team must be composed of two students who are Summit participants. These students must not be the participants of the Summit Interactive.
4. The Engineering Science projects may be made by the entire Science Club; however, only two science club members are to represent the entire School during the judging.
5. There is one (1) Engineering Science Challenge this year, the **Savonius Wind Mill**.
6. Rules and mechanics of the project and registration forms will be available with this file and also accessible in all PSYSC web portals.
    a. Website: www.psysc.org
    b. Blogspot: www.ecatalyst.blogspot.com
    c. Facebook: www.facebook.com/psysc
       www.facebook.com/psysc.nscm
    d. Multiply: www.psysc.multiply.com/links
7. The MathSciAKa Team will be strict to the specifications per Engineering Science Workshop.
8. Registration forms will be available during Summit registration on September 8, 2012.
9. Winners will receive Certificate of Recognition.
10. All participants (students and coaches) will receive Certificates of Appearance and Participation

B. Summit Interactive Workshops

1. This is open to all Summit-participating Science Club.
2. Each participating Science Club can send only one competing team composed of **at most five (5)** Summit student-participants. These students must not be the participants of the Summit Engineering Science Workshops.
3. The Summit-Interactive will have ten (10) stations. Each station shall correspond to one activity or workshop.
4. For schools with less than five (5) participants, they will still be allowed to participate but no challenge will be adjusted for the team.
5. Substitution is not allowed. For the teams who started with less than 5 members, additional members are allowed to join to complete the team even if the competition already started.
6. Each team must accomplish the goal of each activity in a station. Corresponding points shall be awarded.
7. The team shall only proceed to the next station upon the signal to move, whether the team has finished early in a station. The time taken in finishing the activity in the station shall be noted by the proctor.
8. The criteria for winning the Summit-Interactive will be based only on the accumulated points awarded in the stations. In case of a tie, the time factor comes in.
9. Specific areas will be assigned for each station. Going outside this area before the signal to move will create a deduction for the team.
10. Guidelines for the stations shall be given during the event proper.
11. Winners will receive Certificate of Recognition
12. All participants (students and coaches) will receive Certificates of Appearance and Participation

VII. Contact Details

For more information, questions, and clarifications, feel free to contact the following:

PSYSC National Office:
Unit 703, West Mansions Condominium, Zamboanga St.,
Brgy. Nayong Kanluran, Quezon City
(02) 332-8151 or (02) 393-4384

You may also visit the PSYSC web portals:

www.psysc.org
www.facebook.com/psysc.nscm

Or send an email to the MathSciAKa 2012 Core:

mska.nscm2012@gmail.com

VIII. Specific Guidelines

A. Take Home Workshops Bracket I

ORGANIC BATTERY

Checked and reviewed by:

Ms. Sandy Mae A. Gaspay. Institute of Civil Engineering, University of the Philippines Diliman
Mr. John Hero Salvador. Institute of Chemistry, University of the Philippines Diliman

Objectives

This workshop aims to build a battery made from fruits, vegetables, and root crops. Furthermore, the knowledge on electrical circuit will be tested.

Introduction

A battery is an electrochemical cell, or its compilation, that transforms the stored chemical energy in to electrical energy. The principle of the battery relies on the reduction-oxidation reaction of chemicals. As the reaction proceeds, electrons are being transferred from one chemical species to another. This transfer of electron is harnessed in electrodes; as electrons are in motion, they produce current. This current can now be utilized to power appliances requiring electric power.

The first battery was invented by Alessandro Volta in 1800. He utilized alternating copper and zinc plates separated by an electrolyte solution to produce current.

Materials

10 pieces of fruits, vegetable or root crop
Copper electrodes
Zinc electrodes
Alligator clip – wire units
¼ illustration board
Scotch tape

Procedures

1. Pierce the fruits, vegetables or root crops with the one zinc and one copper electrode.
2. Using the alligator clip – wire units, connect all the fruits, vegetables and root crop to each other but leave one copper and one zinc electrode unconnected. Take note of the polarity of the electrodes when connecting them. (i.e.: which terminal is the + and which one is the -)
3. Mount your circuit on a ¼ illustration board with the use of scotch tapes. Test the voltage and current output by a multimeter. Do this by connecting the copper and zinc electrodes to the respective electrodes of the multimeter.

Design Guidelines

1. The participants must build an organic battery according to the mentioned materials and procedure.

2. The total number of fruits, vegetables or root crops in the final project must be ten (10) pieces only.
3. Repetition and combination of varieties and species of fruits, vegetables or root crops are allowed.
4. The circuit connection must have at least three (3) parallel and at least (3) series connections.
5. The slicing, crushing, cutting, juicing, drying, soaking in any solution, cooking, freezing and any other physical and chemical processing of the fruits, vegetables or root crops are not allowed. The materials should be in their virgin and raw form.

Testing Guidelines

Power Rating

1. The Power Rating criterion is 50% of the total score for this project.
2. The current (I) and voltage (V) of the project will be measured using a digital multimeter. The power output (P) will be calculated by the formula P= I x V.
3. The measurement will begin ten (10) seconds after the electrodes are attached to the multimeter. Five (5) readings will be measured after every five (5) seconds. The average reading will be recorded as the final and official reading.
4. The power rating will then be calculated by the equation:

$$Power\ Rating = \frac{team's\ P}{highest\ scoring\ P\ among\ the\ participants} \times 100\%$$

Design Explanation

1. The Design Explanation criterion is 30% of the total score for this project.
2. The Design Explanation should be submitted on the pre-testing, one (1) letter page, Times New Roman 11 point font, double spaced.
3. The Design Explanation should show the simplified circuit diagram of the project, the electron flow mechanism of its power generation, and the importance of each materials used.
4. The explanation will be evaluated by the judges and MathSciAKa staff

Aesthetic Value

1. The Aesthetic value criterion is 20 % of the total score of this project.
2. The Aesthetic value will be evaluated by the judges and MathSciAKa staff.

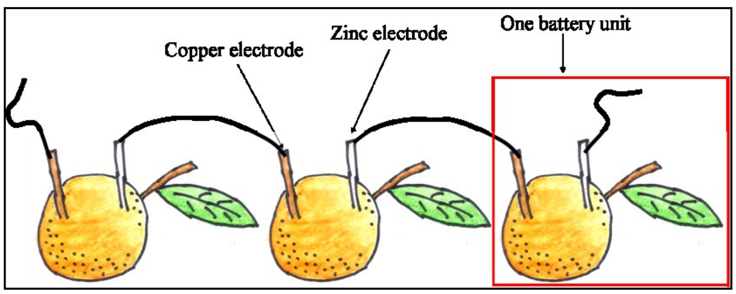
Inspection

1. The Inspection will not contribute any score for the project. However, it may disqualify an entry once a violation of any guideline occurred.
2. The Inspection consists of cutting and slicing the fruits, vegetables and root crops.

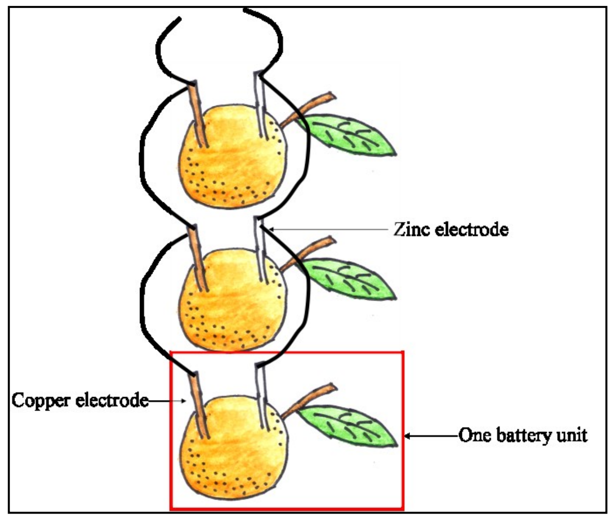
3. The judges and the MathSciAKa staff reserves the right on choosing and how many fruits, vegetables and root crops will be inspected.

Criteria for Judging

Power Rating	50%
Design Explanation	30%
Aesthetic Value	20%
Inspection	0%
TOTAL	100%



Three battery units connected by two series connections.



Three battery units connected by two parallel connections.

RUBBER BAND-POWERED CAR

Checked and reviewed by:

Hernando S. Salapare III, M. Sc.
National Institute of Physics, University of the Philippines Diliman
Université de Nice-Sophia Antipolis

Objectives

This project aims to produce a toy car powered by a rubber band. In addition, the transformation of kinetic and potential energy will be observed.

Introduction

Rubber bands are sources of elastic potential energy. When they are stretched and allowed to relax, the elastic potential energy is transformed into kinetic energy. This transformation is harnessed in this workshop to power a toy car. However, as the kinetic energy is used up as mechanical energy, the car does not go in motion eternally. It eventually stops as a result of transformation of mechanical energy into heat energy caused by friction.

Materials

Plywood/Balsa wood
Ballpen tubes/drinking straws
Thick rubber band
Rubber stoppers
Sewing pin with head
2 pcs Barbeque skewers
Hot melt glue
Small hook

Procedures

1. Cut a 6x4-inch length of balsa wood to be the car body, or **chassis**. Cut a 1x1-inch notch out of one end. Your rear axle will be accessible through this notch.
2. Cut two lengths of ballpen tube the same width as the chassis and glue them at the bottom across the chassis near each end. Trim away the center of the rear piece where it stretches across the notch in the chassis. Make sure the tubes are lined up straight.
3. Obtain the skewers and cut them one inch longer than the width of the chassis. Insert the skewers through the ballpen tubes to create your axles. On the rear axle, carefully pierce a sewing pin leaving enough length to catch a rubber band. Cut or fold the pointed tip.
4. Attach the rubber stoppers to the axles. This will serve as the wheels and they need to be tightly fit on the axle.
5. Screw a small hook above the chassis just behind the front axle.
6. Loop one end on the hook at the front of the car, and loop the other end over the catch on the rear axle.
7. Turn the rear axle several times to wind the rubber band around it, set the car on a smooth hard surface, and let go.

Design Guidelines

1. The participants must build a rubber band powered car according to the mentioned materials and procedure.
2. The only means of propulsion is the potential energy stored in the rubber band. No secondary propulsion system, such as propeller, may be engaged.
3. The use of commercial wings, flaps, fins, and bearings is strictly prohibited
4. The vehicle must be fully autonomous after it leaves the starting line.
5. Participants must strictly follow the guidelines and specifications. Failure to do so will lead to disqualification of the entry.

Testing Guidelines

Displacement

1. The Displacement category is 50% of the total score for this workshop.
2. Thick rubber bands will be provided by the MathSciAKa staff during the testing.
3. The car will be wound 5 times and will be set to run from the starting line.
4. The displacement will be measured by tape measure from the starting point through a straight line to the end point.
5. The score will be calculated as follows

$$Score = \frac{team's\ displacement}{highest\ displacement\ recorded\ among\ the\ participants} \times 100\%$$

Mass

1. The Mass criterion is 30 % the total score of this project.
2. A weighing scale will be provided by the MathSciAKa staff and the project will be weighed.
3. The score for Mass criterion is the percentage of the team's project mass with respect to the lowest project mass. The formula will be

$$Mass\ Score = \frac{lowest\ mass\ recorded\ among\ the\ participants}{team's\ project\ mass} \times 100\%$$

Aesthetic Value

1. The Aesthetic value criterion is 20% of the total score of this project.
2. The Aesthetic value will be evaluated by the judges and MathSciAKa staff.

Criteria for Judging

Displacement	50%
Mass	30%
Aesthetic Value	20%
TOTAL	100%

References

Adapted from "Build a Rubber Band Car" by www.hometrainingtools.com. Last accessed on July 2, 2012.

Sample outputs. Note that the maker used special wheels instead of rubber stoppers.

B. Take Home Workshops Bracket II

PARABOLIC REFLECTOR

Checked and reviewed by:

Hernando S. Salapare III, M. Sc.

National Institute of Physics, University of the Philippines Diliman

Université de Nice-Sophia Antipolis

Objectives

This workshop aims to build the central portion of a light-collecting parabolic disc by utilizing the properties of a parabola. In addition, several recycled and reflective materials will be used to collect light rays and concentrate them in a single point.

Introduction

A parabolic disc is a device used to collect or transmit different forms of energy such as light, sound and radio waves. Its principles and mechanisms are based on the properties of a parabola. The disc follows a certain parabolic function in the form of

$$g(x) = \frac{1}{4f}x^2 \qquad (1)$$

Where f dictates the location of the focus, or focal point, from the vertex of the parabola. So for a parabola following a function of $g(x) = 3x^2$, $\frac{1}{4f} = 3$, therefore, f=1/12.

The focus of the parabola plays a vital role in every parabolic disc. Parallel rays of energy directed toward the opening of the parabola hit the reflective surface laid on the dish. The rays will be reflected and then converge at the focal point. Thus, the intensity of the energy becomes concentrated at this point. Energies are collected and utilized in various applications. In addition to many applications is distant celestial object observation were low-intensity radio waves from outer space are intensified by parabolic satellite dishes. Figure 1 shows the schematic diagram of the mechanism.

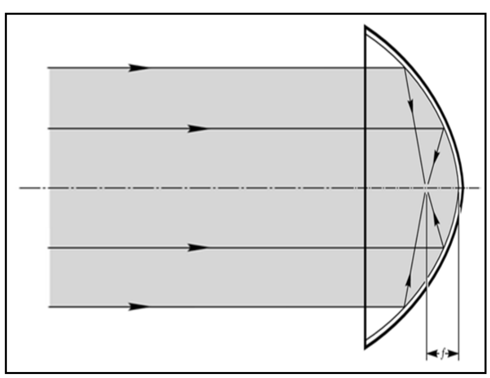


Figure 1. Parallel rays being converged in a focal point of a parabolic reflector.

(source:http://assets.newport.com/ web600w-EN/images/2366.gif)

Design Guidelines

1. The participants must build the central portion of a parabolic dish so that the project looks like a strip of reflective material or reflective panels in a symmetrical parabolic shape. The focal point and inner portion of the project must be cleared from obstructions for testing purposes.
2. The dimensions of the project must lay and fit in a 50 cm length and 50 cm width square, the origin (0,0) is the center of the square. The height of the project is limited to 5 cm. In the construction of the project, assign the 25th cm of left and right of the origin as x=-3 and x=3. For the y-axis, assign the 25th cm above and below the origin as y=3 and y=-3.

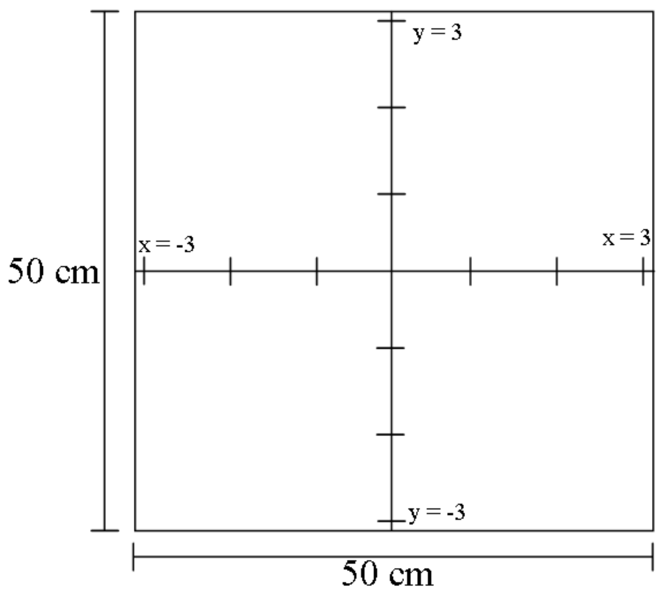


***Figure* 2.** The working dimensions of the parabolic reflector project.

3. The materials for the framework of the project are limited to like illustration boards, papers, folders, scotch tapes and glues only. Recycled materials are encouraged. Specially-made woods, metals, and ceramics are not allowed.
4. The materials for the reflective surface of the project can be anything new or something recycled except mirrors.
5. The associated parabolic function must follow the form of equation (1). Work on an equation resulting to a focus lying outside the parabola (see figure 3A). Focus inside the parabola may not perform well in the competition testing (see figure 3B).

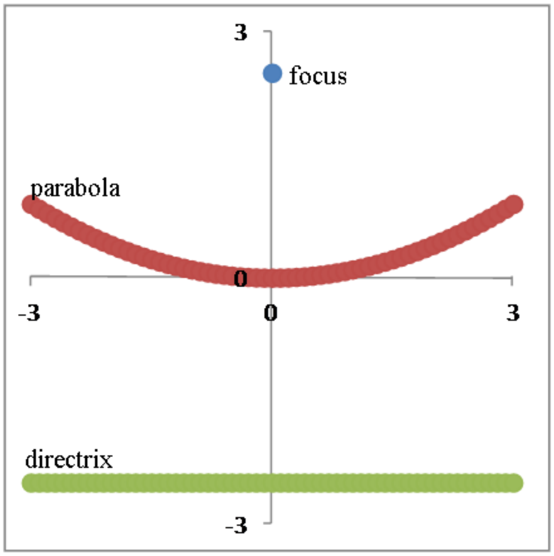


Figure 3A. Correct associated parabolic equation with focus outside the parabola.

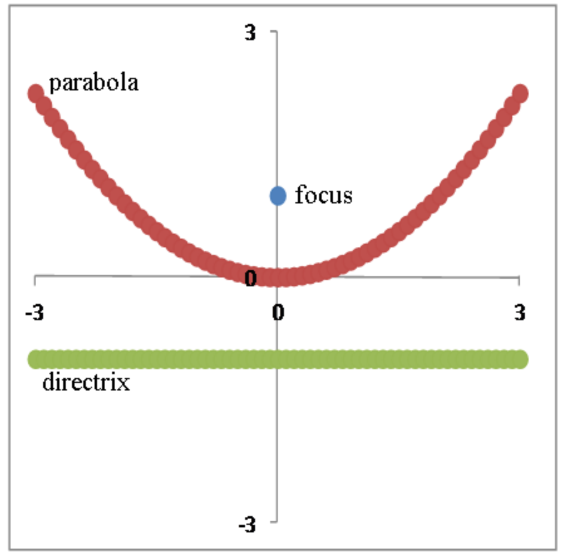


Figure 3B. Wrong associated parabolic equation with focus inside the parabola.

6. The parabolicity of the project may be maintained and supported by another framework made of the same materials as with #3. This supporting framework must not exceed the directrix of the parabola and may be detachable or intact. However, the supporting framework, together with the parabolic reflector must conform to the #2.
7. The project must be handmade. No machine shop fabrication must be involved in the making of the project.
8. Participants must strictly follow the guidelines and specifications. Failure to do so will lead to disqualification of the entry.

Testing Guidelines

A. Parabolicity

1. Parabolicity criterion is 20 % of the total score of this project.
2. A 50 cm x 50 cm Cartesian plane will be made by the MathSciAKa staff. The parabolic part of the project will then be laid in the grid with the vertex adjusted to the origin (0,0) and the focal point lying along the y axis.
3. Twenty five (25) random Cartesian points will be located along the parabola of the project. The points will be plotted in to a parabola using Microsoft Excel™. The best fit equation of the curve and correlation factor, R^2 will be obtained.
4. The score will be calculated as follows

$$parabolicity = R^2 \times 100\%$$

B. Light-Concentrating Ability

1. The Light-Concentrating Ability criterion is 50 % of the total score of this project.
2. The testing for Light-Concentrating Ability will be done in a dimmest room possible.
3. One (1) 220V dichroic halogen lamp will be used as source of parallel light rays. The bulbs will be turned on 20 cm from the open end of the parabola of the project. The bulbs will be used for all testing. In case of a busted lamp, a new identical bulb will be provided.
4. The focal point will be located as declared in the registration proper.
5. A photocell will be used to measure the light-concentrating ability. The photocell is attached with a digital multimeter set at resistance setting.
6. After the photocell is placed on the focus and the project was illuminated, there will be thirty (30) seconds of equilibriation time. Then five (5) resistance readings will be obtained every ten (10) seconds. The average of the resistance reading will be obtained.
7. The score for light-concentrating ability will be

$$Light\ Concentrating\ Ability = \frac{lowest\ average\ resistance\ recorded\ among\ the\ participants}{team's\ average\ resistance} \times 100\%$$

C. Mass

1. The Mass criterion is 20 % of the total score of this project.
2. A weighing scale will be provided by the MathSciAKa staff.
3. The score for Mass criterion is the percentage of the team's project mass with respect to the lowest scoring mass. The formula will be

$$Mass\ Score = \frac{highest\ mass\ value\ recorded\ among\ the\ participants}{team's\ project\ mass} \times 100\%$$

D. Aesthetic Value

1. The Aesthetic value criterion is 10 % of the total score of this project.
2. The Aesthetic value will be evaluated by the judges and MathSciAKa staff.

Criteria for Judging

Parabolicity	20 %
Light Concentrating Ability	50 %
Mass	20 %
Aesthetic Value	10 %
TOTAL	100 %

References

Peterson, Thurman S. *Calculus with Analytic Geometry.* New York: Harper and Row Publishers, Inc., 1950. ; reprint ed., Quezon City: Ken, Inc., 2004.

Young, Hugh D. and Freedman, Roger A. *University Physics with Modern Physics 12e.* San Francisco: Pearson Education, Inc., 2008.

COPPER (I) OXIDE SOLAR PANEL

Checked and reviewed by:

Dr. Len Herald Lim. Institute of Chemistry, University of the Philippines Diliman

Objectives

This workshop aims to produce electricity from solar panel made from copper sheets. In making the project, execution of laboratory techniques and chemical knowledge will also be tested.

Introduction

Solar panel is an electrical package of photovoltaic cells and connecting wires. Altogether and with the aid sun's light rays, the solar panel can produce electrical current that can be used to power up electrical appliances.

The device utilizes the principle of photoelectric effect. First observed by Heinrich Hertz in 1887, this phenomenon is the emission of electron from matter as a consequence of absorption of electromagnetic energy. The most important component of the solar panel is the photovoltaic cell. The cell is made up of photosensitive materials: the ones that exhibit photoelectric effect. Usual materials are silicon crystals, gallium alloys, carbon fullerenes and polyphenylene vinylene. For this workshop, the photosensitive material will be cuprous oxide.

The mechanism of the electron flow in photovoltaic cells starts with the photoelectric effect. Visible or ultraviolet electromagnetic radiation hits the photosensitive material. After the materials get excited, it immediately goes back to its ground state while releasing electrons. Those electrons are then allowed to flow in connecting wires to deliver electricity to appliances. In cases that the energy is not in immediate use, a battery can be provided to store electricity for later use.

Materials

Acrylic fiber glass/glass
Copper plate at least 1 mm thick
Connecting wires and alligator clips
Electric stove / hot plate
Non conductive spacers
Soft paint brush
NaCl solution

Procedure

1. Construct the casing of the solar panel from acrylic fiber glass or glass. The case must be a rectangular hollow prism with an open top and leak-proof. You may also opt to have it done in glass fabrication shops. Improvised materials like old CD cases and clear food containers may also be used. The dimension of height and width limited to 120 and 120 mm respectively. However, the length is for the participants to decide.

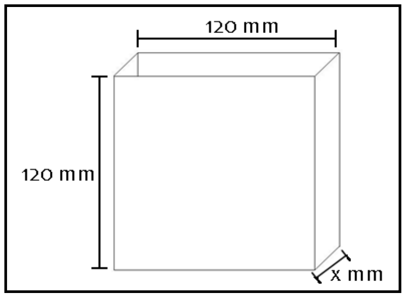


Figure 1. Diagram for the dimensions of the solar panel casing.

2. Cut out 2 pieces of copper plates that will fit in the panel case. Leave allowances on the top for attachment of alligator clips. Extreme care in handling is necessary as sharp edges may be produced. The two plates will be your electrodes.
3. Wash the plates with running water and soap to ensure an oil-free plate. After washing, avoid touching the plates.
4. Obtain one plate and heat it over an electric stove for at least 30 minutes or until the plate is fully covered with black deposits. You will notice a dramatic color change from metallic copper color to a spectrum of red, green, pink and orange patina followed by the deposition of black powder. This plate will be your heat-treated plate. Allow the heat-treated plate to cool over the stove slowly.
5. Meanwhile, prepare an electrolyte solution from commercial table salt.
6. After cooling the heat-treated plate, peel the black deposits with the aid of a soft paint brush. Do not attempt to brush the black speckles briskly as it will remove the necessary oxides. The final product should have a metallic reddish-orange color distinct from the pre-treated copper. It may contain traces of black deposits
7. Assemble the solar panel. Insert the heat-treated plate and the copper plate inside the casing. Insert some non-conductive spacers in between the two plates to prevent them from touching each other. Fill the casing with your electrolyte solution. Attach one alligator clip to each allowance of the plates. Do not connect them.
8. Illuminate your solar panel under light sources. Test the voltage and current output of your solar panel with multimeter. Modify the variables to obtain optimum results.

Design Guidelines

1. The participants must build a cuprous oxide solar panel based from the foregoing procedure.
2. Participants must strictly follow the guidelines and specifications. Failure to do so will lead to disqualification of the entry.

Testing Guidelines

A. Power Rating

1. The Power Rating criterion is 50% of the total score for this project.
2. The testing procedures for power rating criterion will in a dark room.
3. The project will be illuminated 20 cm from a 220V dichroic halogen lamp.

4. The current (I) and voltage (V) in each light source will be measured using a digital multimeter. The power output (P) will be calculated by the formula P=IV.
5. The power rating will then be calculated by the equation:

$$Power\ Rating = \frac{team's\ P}{highest\ scoring\ P\ among\ the\ participants} \times 100\%$$

6. All materials and light sources will be provided by the MathSciAKa staff. In case of a busted bulb, a new identical bulb will be provided.

B. Mass

1. The Mass criterion is 20 % the total score of this project.
2. A weighing scale will be provided by the MathSciAKa staff and the project, without alligator clips and wires, will be weighed.
3. The score for Mass criterion is the percentage of the team's project mass with respect to the lowest project mass. The formula will be

$$Mass\ Score = \frac{lowest\ mass\ recorded\ among\ the\ participants}{team's\ project\ mass} \times 100\%$$

C. Project Quiz

1. The Project quiz will be given on the event proper and shall contribute 25% of the total score of the project. This is to assess the participant's understanding about the chemistry and mechanics of the project.
2. The quiz is a written quiz and consists of different types such as multiple choice, essay type and fill in the blanks.
3. The questionnaire and answer sheet will be given at the start of the testing and will be collected at the end of testing.
4. MathSciAKa staff will check the answers in triplicate. After checkers come in a conclusive score, the rating will be calculated as follows:

$$Rating = \frac{Quiz\ Score}{Perfect\ Score} \times 100\%$$

D. Aesthetic Value

1. The Aesthetic value criterion is 5 % of the total score of this project.
2. The Aesthetic value will be evaluated by the judges and MathSciAKa staff.

Criteria for Judging

Power Rating	50 %
Project Quiz	25%
Mass	20 %
Aesthetic Value	5%
TOTAL	100 %

References

Levine, Ira N. *Quantum Chemistry 5e.* New Jersey: Prentice Hall, Inc., 2000.

Young, Hugh D. and Freedman, Roger A. *University Physics with Modern Physics 12e.* San Francisco: Pearson Education, Inc., 2008.

www.rimstar.org. Last accessed on July 29, 2012.

C. Summit MathSciAKa Engineering Science Challenge

SAVONIUS WIND MILL

Checked and reviewed by:

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National Institute of Physics, University of the Philippines Diliman

Université de Nice-Sophia Antipolis

Objectives

This workshop aims to build a simple electric generator with the use wire coils and magnets. Furthermore, the kinetic energy of the wind will be harnessed to operate the wind turbine and produce a functional generator.

Introduction

These plans are for the construction of vertical axis wind turbine, modeled after a design by the Finnish engineer S.J. Savonius in 1922. His idea was to mount two half-cylinders on a vertical shaft. It was simple to build, and could accept wind from any direction. However, it was somewhat less efficient than the more common horizontal axis turbine. The reason for the difference has to do with aerodynamics. Horizontal axis turbines have blades that create lift to spin the rotor, whereas the vertical axis design we are using here operates on the basis of drag—one side creates more drag in moving air than the other, causing the shaft spin.

This wind turbine model makes its electricity with a simple generator which produces pulses of current, or alternating current. It does so by passing strong magnets over coils of fine wire. Each time a magnet passes over a coil, the coil becomes energized with electricity. With 4 coils connected together in series, the result is a quadrupling of the voltage. This is the simplest and possibly most efficient way to generate electricity, and is the same basic principle used in almost all wind turbines, even the large scale commercial ones. The electricity from a wind turbine varies with the wind speed, so to make practical use of it, you must be able to store it in batteries, or change it into a form that gives a stable, constant voltage. Usually, electricity from wind turbines is converted from alternating current to direct current, which can be used for battery charging.

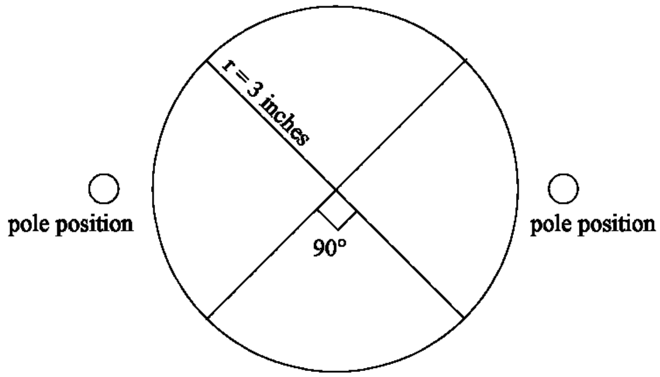
Materials

- Illustration board/cardboard box
- Thin magnet wire
- 4 pieces magnets (~1 inch in diameter)
- Empty Stik-O jar (4 inch diameter)
- Sandpaper
- Thin wood rods and plywoods
- Metal ballpoint
- Balloon sticks
- Hexagon socket screw
- Tapes, scissors, hot melt glue, cutter, ruler
- Hook
- Nails or screws

Procedures

A. Frame and Base

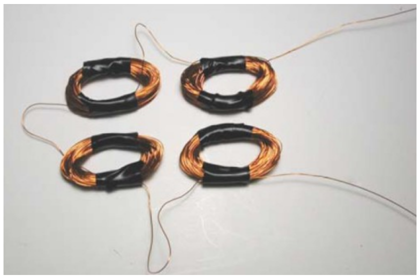
1. Use a pencil, ruler, and compass to mark the base board according to the dimensions in the diagram below:



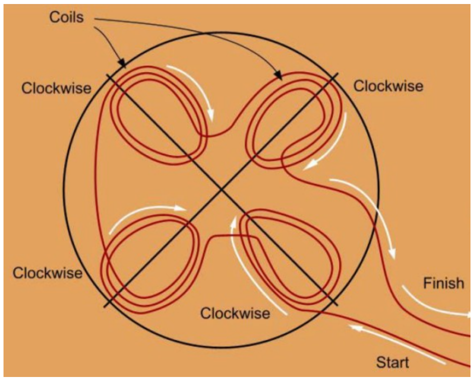
2. At the center of the circle, half drive a hexagon socket screw.
3. Cut 2 pieces of 9-inch wooden rods. Attach two 9-inch poles on the pole position. You may add some braces to ensure a sturdy attachment.
4. Cut 1 piece 8-inch wooden rod, this will be your cross bar. Locate the middle and attach a hook in here.
5. Insert a ballpoint tip at one end of a balloon stick so the stick would have a pointed tip. Secure the attachment by the use of hot melt glue.
6. Using pliers or any appropriate tool, reshape the hook so a balloon stick can freely and steadily rotate inside the hook.
7. Attach the cross bar horizontally on top of the poles.
8. Insert the pointed balloon stick through the hook and allow it to stand in the screw. Again, make sure that the stick rotates freely and steadily. Also, secure that the stick is exactly perpendicular to the base. The final product will is shown below.

B. The Coils

1. Make 4 coils of magnet wire with more than 100 loops each. Secure the shape of the coils by an electrical tape. The size of the coils must be less than the size of the magnet. Be sure that the coils are also connected to each other. Leave about 20 cm of magnet wire, as allowance, before the first coil and after the fourth coil.

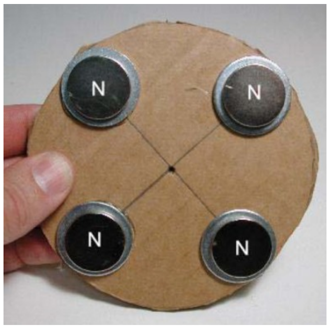


2. Using a sand paper, remove the insulator coating of the magnet wire in the allowance to expose the copper wire.
3. Test if current can run through the coils by checking the resistance of the coil. Resistance values should register relatively low readings in the 200 ohm setting.
4. Mount the coils over your base using hot melt glue. Make sure that the orientation of each coil is the same all over so the direction of current is also the same. Also, put the coils before the edge of the circle.



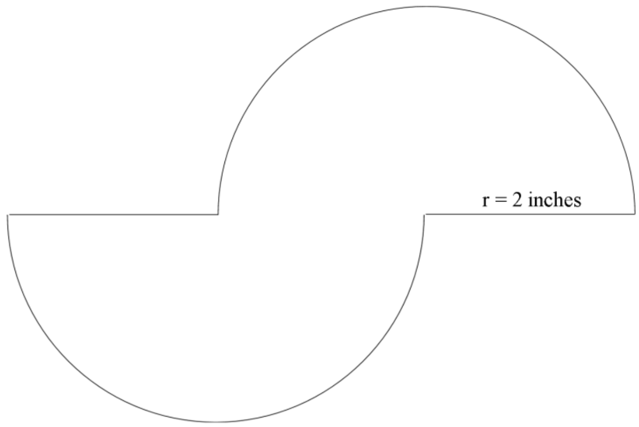
C. The Rotor

1. From a cardboard, cut a circle of radius 3 inches. Using a pencil, draw 2 perpendicular lines similar to that of A1.
2. At the ends of each line, attach your magnet by glue. Be sure that every magnet has the same pole facing upward.



D. The Turbine

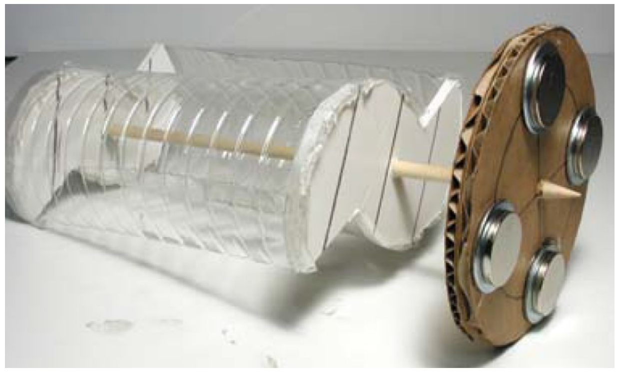
1. Make and cut two pieces of turbine end templates in a cardboard. The turbine end template is shown below.



2. Carefully cut the upper and lower portion of the Stik-O jar so it becomes a perfect cylinder.
3. Cut the cylinder lengthwise to produce two equal halves.
4. Apply hot glue at the edge of the turbine end pieces and immediately attach half of the cylinder. Sanding the edge of the cylinder makes the glue attachment easier.

E. Final Assembly

1. Insert your pre-made shaft through the center of the turbine. Secure it on its position 1-3 centimeters from the cross bar by a hot glue to make sure it does not fall.
2. Carefully insert the pointed end of the turbine shaft through the top of the rotor disk at its exact center. The magnet side should face down.



3. Test fit the turbine-rotor assembly in the frame. Spin the rotor and ensure that:

   a. The turbine turns freely without striking the frame;
   b. The rotor disk does not wobble as it turns
   c. The gap between the magnets and the coils is about 3 millimeters or less.

   Then secure the rotor position by hot melt glue so it does not move in the shaft.

4. You can "micro-adjust" the clearance of the rotor and coil by turning the screw in or out as needed.

5. Test the functionality of your windmill with any wind source. Attach a voltmeter, set at AC setting, to the coil allowance to read the voltage output. Modify the variables to obtain optimum results.


Notes

1. The illustration presented is intended for visual aids only. The materials and actual products, used by the provider, are not the same as that of the Summit-MathSciAKa requirements.

Design Guidelines

1. The participants must build a Savonius Wind Mill based on the foregoing Procedures and Material stated.
2. The frame of the windmill must be made up of wood and can be held together by nails or screws only.
3. The gauge of the magnet wire is of free choice.
4. The number of turns of magnet wire per coil is of free choice.
5. Participants must strictly follow the guidelines and specifications. Failure to do so will lead to disqualification of the entry.

Testing Guidelines

Voltage Output

1. The Voltage Output Criterion is 50% of the total score of this project.
2. The project will be set to operate by an industrial electric fan. There will only be one (1) setting for all of the projects.
3. A digital multimeter, set at AC setting, will be used to measure the voltage output. It will be connected through the 20 cm magnet wire allowance.
4. From the moment the wind mill was operated, 30 seconds will be used for equilibriation. Then five (5) voltage readings will be obtained after every ten (10) seconds.

5. The average of the voltage readings will then be obtained. The score for the Voltage Output criteria will then be calculated as follows.

$$Score = \frac{team's\ average\ voltage\ output}{highest\ average\ voltage\ output\ recorded\ in\ the\ region} \times 100\%$$

Mass

1. The Mass criterion is 30 % of the total score of this project.
2. A weighing scale will be provided by the Summit-MathSciAKa staff.
3. The score for Mass criterion is the percentage of the team's project mass with respect to the lowest scoring mass. The formula will be

$$Mass\ Score = \frac{highest\ mass\ value\ recorded\ among\ the\ participants}{team's\ project\ mass} \times 100\%$$

Aesthetic Value

1. The Aesthetic value criterion is 20 % of the total score of this project.
2. The Aesthetic value will be evaluated by the judges and MathSciAKa staff.

Criteria for Judging

Voltage Output	50%
Mass	35%
Aesthetic Value	15%
TOTAL	100%

References

Adapted from Dave Mussel's "Build Your Own Wind Turbine". The Pembina Institute, 2006.

www.re-energy.ca. Last accessed on July 29, 2012