MODEL SOLAR BOAT CHALLENGE

CURRICULUM UNIT

SWAN HILL PRIMARY SCHOOL

State Government Victoria
Department of Education and Early Childhood Development

SWAN HILL PRIMARY SCHOOL 7142

CENTRAL VICTORIA SOLAR CITY
Local energy solutions.

Australian Government
Solar Cities

Bendigo Bank generation green

CENTRAL VICTORIAN greenhouse alliance

origin

Powercor AUSTRALIA

Sustainability victoria

State Government Victoria

SRA Sustainable Regional Australia

Introduction

In the Solar Boats Challenge students from Swan Hill Primary School work in groups to build, modify and race a model solar powered boat. They learn about solar energy and how it produces electricity. They see how energy from the sun can be used to power a small motor via a solar panel. Through trial and error, students find the most effective positioning of the panel in order to create the fastest boat for a knock-out race challenge.

The unit requires some financial input. At Swan Hill Primary, the solar boat challenge, run by science teacher Phillip Scoles, received funding through the Central Victoria Solar City project, part of the Australian Government's Solar Cities program. Through funding from Central Victoria Solar City, Swan Hill Primary School has been able to purchase materials, such as new class sets of solar panels, for students' boats.

Outcomes

Students build a model boat powered by a solar panel. They see how solar energy can be used to generate electricity and power a motor. Students develop an understanding of how the positioning of a solar panel affects the energy it can generate.

Equipment

Boats

- 1.25 litre soft drink bottles (2 per boat)
- Construction sticks[1]
- 3mm melamine strips (of varying widths and lengths)
- Solar boat cell (1 per boat)[2]
- Marine boat propeller and shaft kit (1 per boat)[3]
- 3V flat electric motors[4]
- Alligator electrical leads (2 per boat)[5]
- 12mm pine strips (2 per boat)
- Coat hangers (2 per boat)

Construction Tools

- Glue gun
- Wire cutters
- Soldering Iron

Pool

- Fishing line (2 x 10m guide lines above pool)
- 4 x 1m dowel/ rods - (to attach guide line above pool)
- 2x10m Wooden Planks, 2x1m wooden planks (for edges of pool)
- Builders black plastic (to line pool)

[1] Available from CAMS www.camartech.com.au
[2] #20 High Perforance (B.P) Available from Scorpio Technology
[3] Available from CAMS www.camartech.com.au
[4] Available from CAMS www.camartech.com.au
[5] Available from CAMS www.camartech.com.au

Suggested duration

3 x 45 minute lessons (minimum) plus 'Race Day' (time dependant on number of students)

Process

Lesson One: Construction

1. Assemble boat as follows:

   Fit two construction sticks to connect the two bottles together.

   Position the construction sticks across the middle of the two bottles. Place one stick lower than the other at approximately 30°.

2. Glue melamine to construction sticks and have students work out best position for the motor and propeller shaft by testing in tub of water to ensure the propeller is fully submerged. Glue the motor and propeller shaft to melamine board (ensure glue does not interfere with movement of motor or propeller shaft).

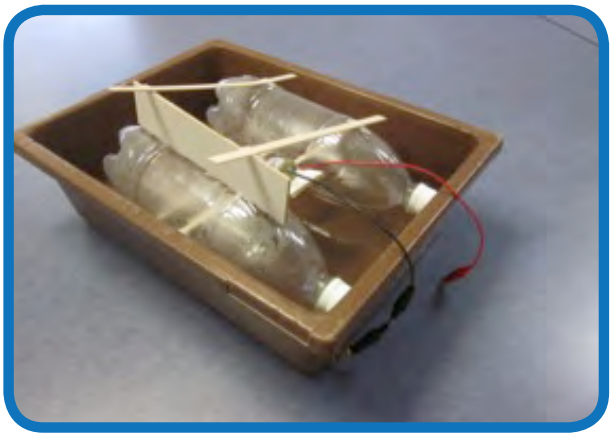
3. Solder alligator clips to motor terminals

Lesson Two: Attaching Solar Cell

1. Have students work out the best position for the solar cell. (This is attached to the boat using a piece of melamine and two construction sticks. The height of the melamine determines the angle at which the solar cell is placed).

   This is where students view the computer data read out of energy produced by fixed solar cells and the solar tracker, located at the school. They will be able to determine the difference between the solar tracker and fixed cells. This will help them understand what the best angle is to fix the cell to their boat in order to achieve maximum power.

   When students have worked out the best angle for their solar cell, choose a piece of melamine with appropriate height. Glue the melamine on one bottle and glue two construction sticks running from the top of the melamine to the other bottle. This creates an angled platform for the cell to rest on.



2. Attach the solar cell to the construction sticks using rubber bands (to allow reuse of the solar cell on future boats).

Lesson Three: Strengthening and Testing the Boats

1. Glue thick construction stick across the front of the bottles (from bottle cap to bottle cap) and across the back of bottles. Glue wire guidance poles (made from coat hangers – hooked at one end) to middle of back and front construction sticks. Glue icy pole sticks to secure guidance wires in place.

2. Test boats in pool. Students can make alterations based on observations of their boat and the boats of fellow students.

3. Construct a small testing pool measuring 4 m by 1m, so students can test their boats before race day. This is essential, as it allows time for improvements to best angle placement of the solar cell.
4. Students can also decorate their boats (the melamine strip beneath the solar panel is a great place to paint a name).

Race day

1. The pool is 10 metres long and 1 metre wide. This allows for two boats to race at a time. To construct the pool, cover wooden planks with black builders plastic. (If possible, place thin foam sheets or newspaper under plastic). Weigh down sides with bricks and fill with water. At each end, attach two poles to the wood (if possible, drill holes in sides of pool and insert the poles). Tie fishing wire from a pole at one end to the pole at the other end. This creates a guide line for the boats. The wire needs to be approximately 300mm above the water.
2. Students race their boats. Ensure they begin by holding them at the starting end, ensuring they have hooked their guide wires over the guide lines.
3. Students compete in a head to head, 'knock out' fashion until an overall champion is found.

Victorian Education Learning Standards (VELS)

This unit is suitable for students working towards Level 4 (Years 5 and 6).

This unit covers the following Progression Points across several Domains:

Science:

Progression Point 3.25 Science knowledge and understanding:

- Awareness of the connections between concepts related to one or more of matter, space, energy and time.
- Knowledge of components of systems

Progression Point 3.25 Science at work

- Planning and reporting of experiments, including statement of purpose, list of materials and equipment and labelled diagrams that explain procedures.
- Application of safe and ethical procedures in performing experiments, including responsible handling of standard equipment and materials.
- Construction of a simple model, following teacher directions that illustrate a scientific concept.
- Knowledge of sustainable practice undertaken in the home and in the local environment.
- Knowledge of a social impact in science.

Progression point 3.5 Science knowledge and understanding

- Comparison of how people in a wide range of occupations and cultures use science in their work and leisure.

Design, Creativity and Technology

Progression point 3.25 Investigating and designing

- Teacher-directed collection of data relevant to a design brief

Progression point 3.25 Producing

- Use of familiar tools and equipment, with teacher instruction on appropriate and safe handling

Progression point 3.5 Analysing and evaluating

- Modifications to their designs/products/systems in response to teacher and peer feedback

Interpersonal Development

Progression point 3.5 Working in teams

- Problem solving strategies for overcoming difficulties to achieve tasks
- Skills in developing a shared understanding of tasks and team plans
- Readiness to give and accept constructive feedback about performance

Links

Scorpio Technology - Technology Materials for schools
www.scorpiotechnology.com.au/

CAMS - Craft and Technology supplies for schools
www.camartech.com.au/

Acknowledgements

We would like to acknowledge the passionate and tireless work of Bruce Stevens, science teacher at Swan Hill Primary School, in developing and driving this program at their school and making the benefits and potential of renewable energy come alive to students.

Central Victoria Solar City is part of the Australian Government's Solar Cities Program, a partnership between all levels of government, industry, business and local communities to trial sustainable energy solutions. Central Victoria Solar City Consortium members include Bendigo and Adelaide Bank, Central Victorian Greenhouse Alliance (CVGA), Origin, Powercor and Sustainable Regional Australia, the commercial entity set up by CVGA to manage the project. This project is also supported by the Victorian Government Sustainability Fund and Sustainability Victoria.

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