FLEET ARC CENTRE OF EXCELLENCE IN FUTURE LOW-ENERGY ELECTRONICS TECHNOLOGIES

Oakleigh Library school holiday workshops 2023. Evaluation

Date: 27 September 2023
Venue: Oakleigh library
FLEET members
Jason Major
Kenneth Choo

Overview

Monash City Council contacted FLEET and asked if we could run school holiday programs at the Oakleigh Library. We arranged to run two workshops: Blast off: look out below, and Fire and brimstone. Playing with electricity.

The objectives for both workshops were less about formal learning and more about providing a fun way to engage children with science and physics. I outline specific objectives below, but unlike workshops conducted with schools, I allocated less time to pre- and post-evaluation activities and more on letting the children play with the catapults and circuits. There are limitations therefore on the conclusions that can be drawn about the impact of the workshop relative to the objectives outlined below.

The age range was set at 7-11 though most participants were between 7-9 with a couple younger siblings that participated also. Both sessions were fully booked.

Number of participants: 40 (20 per workshop)

Workshops

Given the emphasis on hands-on learning, the specific workshop objectives noted below are ideal objectives. It is unlikely, especially given the young age of some participants, that these objectives will be met in this form of workshop. They key objective, as noted above, is that they enjoy engaging in a scientific activity.

Blast off: Look out below. a high energy and deep-thinking workshop on forces and motion, where participants get to build and modify catapults and test them out in a competition against other workshop participants.

Objectives

- To understand the basic concept of energy and conservation of energy
- Understand the difference between kinetic and potential energy
- To think critically about how we (society) use energy

Fire and brimstone. Playing with electricity. An examination of electricity and circuits and the role of atoms. Participants build circuits using a 9V battery, pencils and an LED.

Objectives

- To have participants understand the basics of electricity, conductors, insulators and the structure of the atom
- To think critically about how we (society) use electrical energy
- An understanding of the features and functions of circuits

Method

Each workshop involved a brainstorm that represented the pre- and post-evaluation activity, an introduction to FLEET and hands-on activities.

Brainstorm

Each workshop started with a brainstorm and asked the participants what came to mind when they thought of either electricity (Fire and brimstone workshop) or energy (Blast off workshop). Participant responses were recorded on a whiteboard. For the catapults workshop, this was repeated at the end of the workshop. In the Fire and brimstone workshop, students were asked to write or draw their responses on the back of the paper they drew their circuits on.

Introducing FLEET

After the brainstorm, we introduced FLEET's research and the motivation for their research, which was framed around the problem of the increasing energy consumption of digital technologies. Because these workshops were effectively 50 minutes once you account for latecomers and getting kids seated and quiet, the time to examine FLEET research problem and our research was kept brief (approx. five minutes).

Hands-on activities

Blast off – catapults.

Ball drop

Following the pre-evaluation exercise, students were introduced to the difference between kinetic and potential energy, and the transfer of energy using the ball drop demonstration. The ball drop demonstration involves placing a tennis ball on top of a basketball and dropping the two from a height simultaneously.

Building catapults

Participants used and modified the catapult that is described in the FLEET home science experiment found here - https://www.fleet.org.au/blog/catapult/ Working in teams of 2-3, participants had to apply the physics of potential elastic energy stored in the rubber bands and the icy pole stick, to do three tasks:

1. Test out the pre-built standard catapult. Participants could for example, adjust the fulcrum point of their catapult and observe the height and distance their catapult flung their projectile.
2. Participants modified their catapults in a way that would (hopefully) fling their projectile further. Participants had to come up with a prediction/hypothesis for what their modification would do, test that idea and observe the effect.
3. Participants used their modified catapults in a competition against the other participants to see whose catapult flung the projectile furthest.

Fire and brimstone. Before the circuit building activity, participants watched FLEET members demonstrate what happens when you place a 9V battery onto steel wool – it catches fire. A short discussion occurred with the participants about what was happening and linking this to how a circuit works. Participants were then introduced to the basic structure of atoms, the role of electrons in generating an electrical current and the basic structure of a circuit.

Building circuits
Participants then built graphite circuits based on the FLEET Schools resource, Graphite Circuits.

Students built graphite circuits. As part of the activity, they considered the following tasks: How long could they make their graphite circuits before the LED stopped working, and observe what happened to their working LED the further it got from the battery.

Results

The results for this workshop are based on a comparison of the pre- and post-workshop responses to the brainstorm question. There is feedback from one participant forwarded on from the library to FLEET that is also included.

Brainstorm evaluation

The comparison of the pre- and post-activities were developed to help understand how well we met the specific objectives for each workshop. The responses for each workshop are in Tables 1 and 2 below.

Table 1. Fire and brimstone. Playing with electricity. Pre- and post-workshop responses to the question, what comes to mind when you think of electricity

Pre-workshop responses	**Post-workshop responses (each row = individual participant response)**
[random facts] Lightning is hotter than the outer layer of the sun	Energy, the energy
[Used to conduct electricity] Batteries; circuits; wires	I think about geothermal energy, phones, TVs and static electricity
[Generating electricity] Wind; solar energy; geothermal; fire	Energy, geothermal energy, wind, solar, battery, proton, electron, neutron, wires, the Sun, heat (hotness).
[Tech using electricity] Phones; different tech; robotics and code to make motors work; motors	Proton
	Lightning, static electricity, solar energy
	Lightning, static electricity, solar energy
	Batteries, circuit, proton, positive, negative, neutron, electrons, atoms, light, science

	Energy means power, a form of electricity, phones, cars, etc, wind, tech, solar power
	Energy contains electrons, protons and neutrons. They power up things like devices. Electrons go through the circuits that can power up things. Graphite can have an almost perfect amount to power things up. There was an activity where you had a battery, LED and a pencil that has graphite in it. You had to make the LED light up on the thick lines
	Energy means power, technology, electricity, windy and tech, solar

Table 2. Catapults. Force and energy. Pre- and post-workshop responses to the question, what comes to mind when you think of energy

Pre-workshop responses	**Post-workshop responses**
Friction; static electricity	Kinetic; force; friction; potential energy
Solar; wind; geothermal; fossil fuel; nuclear	Rocket; helicopters
Kinetic energy - movement	The stick becomes tense and bends
Planes; rockets	

Fire and brimstone

Responses in the pre-workshop brainstorm came under the following four broad themes:

- Random facts: one random fact comparing the heat generated by lightning and the sun)
- Used to conduct electricity: components in a circuit used to conduct electricity such as wires and batteries
- Generating electricity: what we use to generate electricity such as wind and geothermal energy
- Tech using electricity: gadgets that use electricity

In the post-workshop brainstorm, students worked individually or in groups and wrote on the back of their circuit paper their responses to the question, what comes to mind when you think of electricity.

The same themes emerged in the post-workshop responses and a number of responses were similar to those in the pre-workshop brainstorm such as the examples of tech that use electricity or terms such as battery, solar and wind.

Additional responses included terms such as proton, neutron and electron, atoms, static electricity. Two participants wrote longer explanations that included descriptions on how they thought electricity worked (“Energy means power, a form of electricity.” “Energy contains electrons, protons and neutrons. They power up things like devices. Electrons go through the circuits that can power up things.”).

Catapults

The differences between the pre- and post-workshops brainstorms in this instance are not great enough to indicate any shift in learning.

Testimonial

One parent sent feedback about the FLEET workshop to the library. See below.

> Thank you [Monash Library] for the photos. It was an amazing session. [Participant] was very excited and enjoyed every experiment. Thank you for organising the event.

FLEET observation

Our observation is subjective and limited because a lot of our focus is on keeping to time, and trouble-shooting problems such as LEDs not working, or fixing broken parts of catapults. Our ability to step back and observe how well participants engage is limited. But, from this limited and subjective observation there was excitement and engagement with each activity, especially with the circuits when kids eventually got their LED to work.

Discussion

Only pre- and post-workshop data from the Fire and brimstone workshop is discussed here because there is insufficient data from the catapult workshop to draw any conclusions. There were sufficient differences in the pre- and post-workshop responses as outlined in Table 1 to suggest that participants did leave the workshop with a greater understanding of electricity, the role of the electron and how a circuit works.

There was no evidence in the post-workshop brainstorm activity of either workshop to suggest participants were thinking critically about how they and society use electrical energy. This is likely because of the shortened time frame to discuss this compared to school-based workshops and also the lack of emphasis of this issue during the hands-on activities.

The testimonial and anecdotal evidence from FLEET observations suggest that most, if not all, participants were engaged in the science and enjoyed the activities.

FLEET reflection

While FLEET achieved the broad objectives of these workshop (engagement with science and physics), should we desire to get greater critical thinking and awareness of the FLEET research problem in this form of workshop, then we should make a conscious effort to integrate this into discussion with kids during the hands-on activities and post-workshop reflection/evaluation. This can be difficult if there is insufficient context and where kids are focused on making things in the activities work, but it is something to think about.