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BANKSIA GARDENS COMMUNITY CENTRE

BUILDING SUSTAINABLE BEHAVIOURS: INTERACTIVE DISPLAYS FOR COMMUNITY EMPOWERMENT

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Building Sustainable Behaviours:

Interactive Displays for Community Empowerment

An Interactive Qualifying Project
Submitted to the faculty of Worcester Polytechnic Institute in partial fulfilment of the requirements for the Degree of Bachelor Science

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Abstract

The Banksia Gardens Community Centre, located in Broadmeadows, Victoria, Australia, aims to educate and motivate their community about sustainable construction and affordable practises through the Building Demonstration Program. The main focus of the Building Demonstration Program was to create engaging materials and interactive displays to educate visitors of the community centre about the sustainable features of the building. From the information our team gathered through research, building tours, observations and interviews, we tailored the Building Demonstration Program to everyone in the community. We hope that our displays will instil a sustainable mindset and empower the community to adopt sustainable measures.

Executive Summary

Over the past few decades, environmental sustainability has become a rising global and local concern. Due to past actions that have depleted natural resources and interrupted weather patterns, movements towards environmental sustainability are essential to sustain life for future generations. Currently, a variety of efforts to incorporate sustainable construction and integrate sustainable practises to daily routines have begun the efforts to reduce the negative effects humans have on the planet.

Banksia Gardens Community Centre is currently constructing a new sustainable classroom and renovating their existing building. The construction has inspired the establishment of the Building Demonstration Program. The main focus of the Building Demonstration Program is to develop engaging materials to educate the visitors of the community centre about the sustainable features of the building as well as sustainable practises. During our time working with the centre, we created interactive displays to teach the community about sustainability, simple practises, and the different sustainable features the Centre has added to the building. Additionally, we made recommendations for the community centre about other displays that we brainstormed and that can be incorporated into the centre in the future.

We conducted extensive research that supplied us with a strong background in the concerns of an unsustainable culture, sustainable construction, sustainable practises, and techniques for motivating and teaching environmental and sustainable topics to the community. We focused our investigation on climate change, energy consumption and efficiency, water use and conservation, pollution, sustainable construction and materials and practises including recycling, composting and use of community gardens. From this research we also became acquainted with various sustainable materials and methods for construction. Some of these materials and construction methods included solar panels, double glazed windows, recycled sheathing, storm water collection tanks, the orientation of a building, clerestory windows, and passive ventilation techniques. Findings from the research of practises in sustainability enabled

us to identify simple and affordable sustainable routines such as taking public transportation, air-drying clothes instead of using a dryer and remembering to unplug electrical appliances. Lastly, by understanding the concepts of environmental education and its effects on community-based and individual learning, we revealed some ways to teach and motivate different people based on their different learning styles.

We identified qualitative tools, including participant observations, interviews, tours, and surveys that were helpful in assisting us to gather the necessary information that we used to fulfil our objectives and complete our project. Our objectives were:

- To assess the communities' interest and knowledge in environmental sustainability.
- To identify sustainable and non-sustainable features in the community centre, other office buildings and in the homes of Broadmeadows residents.
- To design interactive displays that engages the community at the centre.
- To create the above designs to teach the visitors of the centre about sustainability and sustainable practises.
- To assess the effectiveness of the displays created.

In order to assess the community's interest and knowledge level in environmental sustainability, we observed and directly interacted with the youth and community members by attending holiday programs and courses at Banksia Gardens Community Centre. We also interviewed Banksia staff members. From these observations and interviews, we learned that Broadmeadows is a disadvantaged area, and the people do not prioritise environmental sustainability. However, there is a small population at Broadmeadows that either want to learn more information about sustainability or are already knowledgeable about the topic. Through the holiday programs we also learned that the youth of the Broadmeadows community are more motivated to learn if the information is put into an interactive setting.

We identified sustainable features at the community centre and the new classroom as well as sustainable features in other sustainable buildings. By interviewing Jaime de Loma-Osorio Ricon, our project liaison and the Community Development Coordinator at Banksia

Gardens, and Hao Lee, the architect who designed the new classroom, we learned about the sustainable features located at the centre. We attended tours of three Green Star accredited sustainable buildings in Melbourne, and a housing development in Broadmeadows to learn about sustainable features in large office buildings and the features put into a typical Broadmeadows home. Conducting interviews with the architect and touring sustainable buildings allowed us to relate features that are included in both large and small sustainable buildings. This helped us determine which features were important to showcase in our displays. Some features and concepts we found important to sustainable office buildings and homes included natural and energy efficient lighting, window blinds, rainwater collection tanks, effective ventilation and plants.

We designed and selected the best-suited displays and activities to engage the Broadmeadows community by brainstorming our ideas using the information we gathered from a variety of sources including our visit to the Scienceworks museum and our interview with the Public Programs Manager, Pennie Stoyles, and the Exhibition Manager, Andrew Lewis. We also used information gathered from our interviews with Megan Bond, an Eco-Warrior, Georgina Murphy, the head of the environmental team at the Hume City Council, and Peter Lazarus, the tutor of the Introduction to Sustainability course offered at Banksia Gardens Community Centre. We utilised the concepts of audio, visual and kinaesthetic learning and motivational tactics to effectively brainstorm a total of 24 displays and educational activities. We also generated a description for each of the displays that included a location for the display, the materials required to create the display, and a concept of the display and what it would teach the community. Due to our time constraints, we could only create a select few displays from our brainstormed list. To determine the most effective and beneficial displays to implement, we used structured decision-making tools. We ranked the nine criteria of risk, time, cost, aesthetics, maintenance, ease of use, versatility, personal relevance, and interactivity based on importance and created a rubric that helped us make decisions during our selection process.

We then used a selection process to choose ten final display ideas, and we created six of them. The six displays we created were:

- Promotional posters showcasing leaders in the community performing sustainable practises,
- Informational posters explaining climate change and biodiversity, energy conservation, water conservation, recycling, composting, and pollution,
- Self-guided tour displays of the building, highlighting ten different sustainable materials and designs the Centre incorporated in their building and new classroom,
- A recycling centre painted with pictures showing the different item that go into each bin,
- A "What am I?" scavenger hunt activity to help the youth engage in the self-guided tour, and
- Indoor plants placed around the centre to improve air quality.

We assessed the success of the interactive displays and educational activities by having people with varying levels of interest and knowledge participate in a trial tour. We distributed pre- and post-surveys in order to measure the knowledge gained by the participants and to receive feedback for improvements to make to the displays before final printing. Through this process we learned that the community had some knowledge about the issues of environmental sustainability and basic practises before partaking in our trial tour. After our trial tour they retained knowledge about the causes and effects of environmental sustainability as well as sustainable practises they can exercise.

Since we received positive feedback from our trial tour we believe that our displays were successful additions to Banksia Gardens Community Centre. We also believe that it would be helpful to the community if Banksia Gardens creates other displays that highlight environmental sustainability and simple practises. We have organised a group of environmental volunteers and recommended that they create the remaining displays on our list of brainstormed ideas. We also proposed other suggestion to Banksia Gardens Community Centre that we believe will help shift the community members to more sustainable mindsets.

Through these suggestions and the displays we created, we believe that with encouragement, the members of Banksia Gardens Community Centre have the necessary resources to become environmentally active.

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1.0 Introduction

In recent decades, a primary objective of many countries has been to establish and to develop a "greener," more environmentally sustainable society. Understanding what this means begins with understanding the terminology. The terms "sustainable" and "green" have distinctly different meanings, but are commonly interchanged. The meanings of the terms have become vague due to overuse. "Sustainable" refers to the relationship between economic, environmental, and community development, whereas "green" is a more specific term that focuses solely on the betterment of the environment (Living Green, 2010). The Australian Department of Sustainability states, "sustainability means managing our development so that we do not limit the option of future generations" (The State of Victoria, 2010). A definition from the School of Architecture and Construction Management of Washington State University states "sustainable means using methods systems and materials that will not deplete resources or harm natural cycles" (Mahaffy, 1999). From these definitions, we understand sustainability as developing a lifestyle that does not borrow, destroy, or exhaust natural resources in such a way that harmfully affects the environment, or prevents or inhibits future generations from using such resources.

Common environmental concerns around the world include energy consumption, efficient water use, pollution, and waste management. Sustainable materials and practises can be used to help alleviate these concerns. Therefore, organisations have been established in various countries to address and propose sustainable solutions to these global issues. The Banksia Gardens Community Centre, located in Broadmeadows, Victoria, currently offers a variety of educational programs to all residents. These programs range from performing arts classes to learning about cultural awareness to health and fitness classes and many more. Banksia also offers programs that actively contribute to the development of a "greener" global community. These programs are part of a project known as the Community Empowerment for a Green Tomorrow supported by the Eco-Living Grant Program. Since 2008, this program has

been funded by the Sustainability Fund and led by the Banksia Eco-Warriors (Banksia Gardens Community Centre, 2010).

The Eco-Warriors work to improve local awareness of the seriousness of global destruction, and educate residents about possible options for a sustainable lifestyle. The Eco-Warriors' goal is to promote a community that does not use natural resources in such a way that harms the environment and inhibits future generations from using these resources (Banksia Gardens Community Centre, 2010). To further these goals, the Banksia Eco-Warriors, in cooperation with Worcester Polytechnic Institute (WPI), has developed a Building Demonstration Program to inspire community awareness about environmental sustainability. Facilities at Banksia Gardens Community Centre are currently being renovated and a new sustainable materials classroom is being constructed. We have worked in collaboration with the community centre to produce interactive tools to educate the whole community about the importance of environmental sustainability through the Building Demonstration Program. These educational materials have been placed around the community centre to help bridge the knowledge gap between the experts and the community, and to enhance the community's interest in the new sustainable classroom.

2.0 Literature Review

Our project goal for the Building Demonstration Program at Banksia Gardens Community Centre was to create an interactive and engaging display of the features of the new sustainable classroom to educate and motivate the community about the concerns and importance of environmental sustainability. We aimed to use these displays to introduce affordable, simple sustainable practises to the community, which they can utilise and incorporate into their daily lives. In order to develop a successful plan for this project, we conducted research on climate change, pollution, biodiversity and energy, water and natural resource consumption to learn about their affects on environmental sustainability. In addition we investigated the concepts of sustainability pertaining to construction and possible practises community members can understand and integrate into their everyday lives. We also researched effective ways to empower a community and different learning styles. We utilised these findings to develop an efficient plan of action to accomplish our goals.

2.1 Importance of Environmental Sustainability

In recent decades the importance of environmental sustainability has become apparent. This importance originated because of social, economical and environmental concerns. Concerns like depleting resources, melting ice caps and growing landfills have raised the need for change. Government regulations and goals to reach environmental sustainability have been set because of the increased awareness of the effects of climate change, pollution and energy, water and natural resource consumption on the environment (Vlek, 2007). Through environmental sustainability, governments and individuals hope to protect raw materials and ensure that waste does not keep piling up in landfills and harming our environment (Goodland, 1995),

2.1.1 Climate Change: Causes and Effects

The Earth's atmosphere functions like a blanket and surrounds the earth and works to keep the earth warm, specifically at a temperature that can sustain life (Cleaner Climate, 2011).

There are many gases that compose the blanket known as the atmosphere, and some of these gases, carbon dioxide, methane and nitrous oxide, are greenhouse gases (NWS Department of Primary Industries, 2011). Currently, unhealthy levels of greenhouse gases are entering the atmosphere and are threatening the stability of the earth's temperature. Scientists believe that greenhouse gases alter the Earth's climate through the process known as the enhanced greenhouse effect.

The sun emits visible light and ultraviolet radiation, towards the Earth. The Earth converts the visible light and ultraviolet radiation into heat energy, known as infrared radiation. The Earth absorbs some of the heat energy and radiates the rest of the energy into the atmosphere. Some of this radiation passes through the atmosphere and into space, and the greenhouse gases absorb the rest. The greenhouse gases then re-emit the radiation toward the Earth. This process is known as the greenhouse effect. However recently there has been an increase in concentration of greenhouse gases, due to air pollution caused by driving petrol- and diesel-fuelled cars and industrial business (Liverpool City Council, 2011). The increased concentration of greenhouse gases that have entered the atmosphere has increased the amount of heat that is being re-emitted back toward the earth (Australian Government: Department of Climate Change and Energy Efficiency, 2011; NWS Department of Primary Industries, 2011).

This enhanced greenhouse effect is affecting our climate. The Earth now has a higher average sea and air temperature due to the enhanced greenhouse effect (Australian Government: Department of Climate Change and Energy Efficiency, 2011). The average temperatures in Australia rose by one degree Celsius during the 20th century (Australian Government: Bureau of Meteorology, 2011). Due to this increase in temperature, ice caps and glaciers are melting, and the oceanic and atmospheric circulation patterns have changed, which has caused alterations in wind patterns and rainfall (Australian Government, 2011). This disruption to the Earth is not only affecting the climate but also the Earth's biodiversity (Australian Government: Department of Climate Change and Energy Efficiency, 2011).

"Biodiversity is the variety of all living things" (Australian Museum, 2011). It can be categorised into three different groups: genetic diversity, species diversity, and ecosystem diversity (Australian Museum, 2011). Detailed knowledge of the effects of climate change on biodiversity is limited; however, some studies do show how climate change affects ecosystems. Alterations in wind patterns and rainfall directly affect ecosystems' boundaries. One study showed that the boundary between a prairie made of tall grass and a prairie made of mixed grass moved due to rainfall and temperature changes. This shift allowed one ecosystem to become larger by forcing the other one to diminish in size, which made it unable to sustain certain species (Bualch, 2004). Another example of climate change can be noticed when dealing with the transformations of the ecosystem of Australia's Great Barrier Reef. Since 1979, there have been eight mass bleaching events, which were caused by abnormally high sea surface temperatures (Australian Government; Department of Climate Change and Energy Efficiency, 2011). Through these examples, it can be noticed that the effects of climate change are impacting the earth's ecosystems. However, actions can be taken to reduce these negative effects on the climate and develop a society that is more sustainable.

2.1.2 Energy Consumption

The amount of energy the global community consumes on a yearly basis has raised concerns about future supply, depletion of energy resources, and severe environmental impacts. According to a study conducted in 2007, primary energy consumption and carbon dioxide emissions have increased 49% and 43% respectively between 1984 and 2004 (Perez-Lombard, Ortiz, & Pout, 2008). Figure 1 shown below depicts the amount of household energy consumption in Australia in 2007 (Holt, 2008).

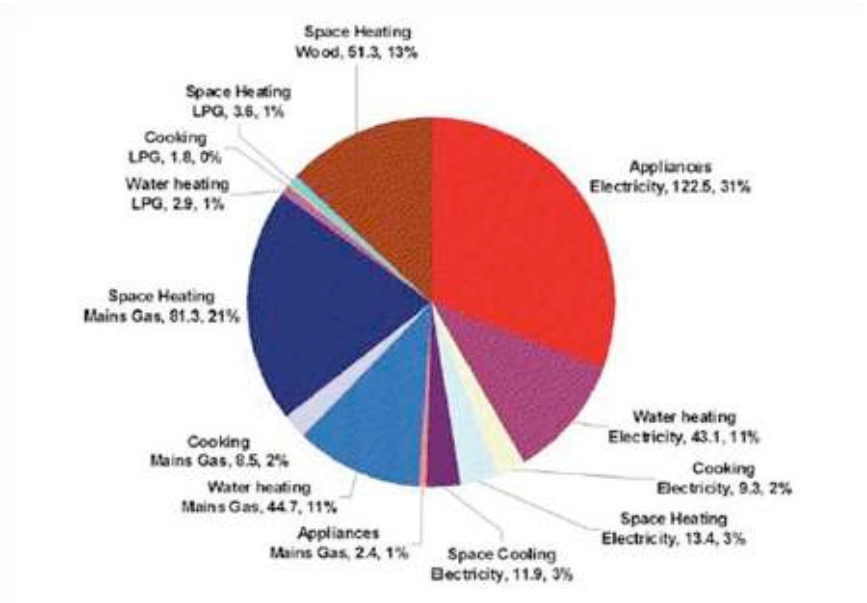

Figure 1: Pie Chart of Energy Consumption (Holt, 2008)

In 2005 the total energy consumption per capita of the world was 1,778 kilograms of oil equivalent (kgoe) per person and Australia's was 5897.5 kgoe per person (International Energy Agency, 2007). Globally, conventional buildings are responsible for approximately 40% of the annual energy consumption. The energy consumed most is for the provision of lighting, heating, and air conditioning (Omer, 2008). Current predictions show that the trend in increased energy consumption will continue. The article states that energy use among countries with emerging economies (in Southeast Asia, the Middle East, South America, and Africa) will increase at an average rate of 3.2% annually and will exceed the amount of energy consumed by developed countries, which will only grow at an average rate of 1.1% annually, by 2020 (Perez-Lombard, Ortiz & Pout, 2008). These observations confirm the relationship between energy consumption and economic development. As the economy in developing countries strengthens, globalisation, demands for better living conditions, and development of communication networks will undoubtedly begin to occur (Perez-Lombard, Ortiz, & Pout, 2008). Consequently, a rise in population in these newly developing areas will increase the demand for energy, exhaust natural resources, and cause serious environmental impacts if current energy systems are not adjusted.

2.1.3 Water Consumption

The essential problem with water use in the world today can be understood simply by comparing it to a supply and demand curve. The global population is growing rapidly, putting more pressure on our water supply; however, the amount of potable water is effectively being reduced by pollution and contamination (Wood, Pan & Sheffield, 2009). The amount of water contained on the Earth is essentially the same at all times because the water cycle is a closed system. Water put into the system via runoff, or precipitation, is eventually removed by evaporation, transpiration, and withdrawal. The only part of the cycle that is appropriated by humans is water held as surface water or in shallow aquifers (University of Michigan, 2000). As a result, humans have essentially taken water out of the system by contaminating some surface water or aquifers. To mitigate the effects of water pollution and contamination, sustainable practises, such as purification systems, gray water filtration, and rainwater use must be employed to maintain a sufficient amount of usable fresh water. These practises effectively use recycled water to ensure the future of this resource (White and Fane, 2007).

2.1.4 Natural Resource Consumption

Between 1980 and 2002 the yearly resource use of the world's economy has increased by about one third. This shows how the demand for natural resources has become a severe threat to the environment due to its recent acceleration (Behrens, 2007). Figure 2 shows the global consumption of resources from 1980 to 2002 (Behrens, 2007).

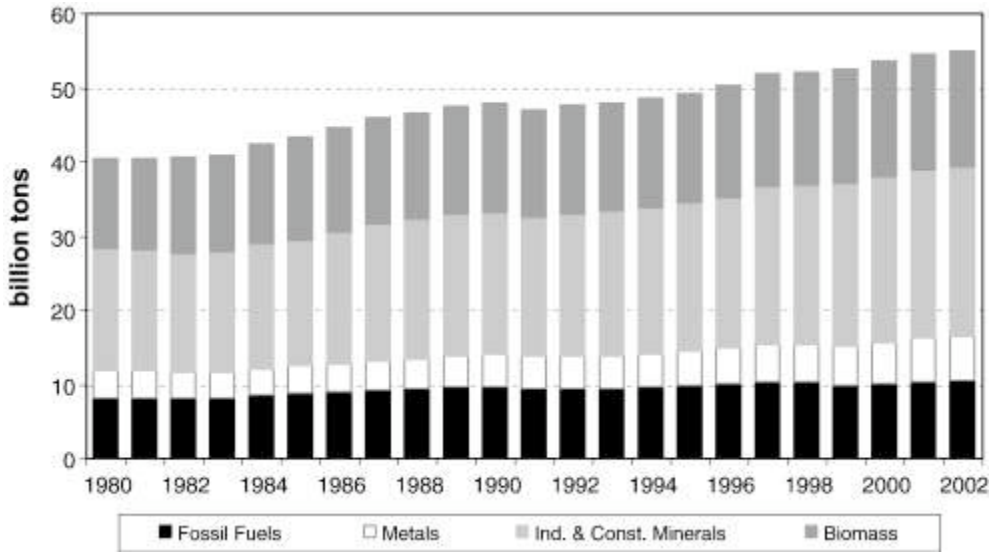

Figure 2: Global Used Resources Extraction by Material Category (Behrens, 2007)

These show how the consumption of natural resources has increased and if no changes are made our resources will soon run out.

In addition the waste created by our natural resource consumption leads to land pollution. Land pollution is a very big threat to the natural environment. It can be caused by poor agricultural practises, pesticide use and poor waste disposal practises. Poor waste disposal practises have caused issues with landfills. There is so much waste being thrown into landfills, space is becoming limited and concerns about where to dispose this increasing amount of waste is posing a major problem (CSIRO, 2007).

2.1.5 Finding Solutions

The environment is changing due to pollution, and energy, water and natural resource consumption. In order to stop our damage to the earth, environmentally sustainable practises have begun to be introduced and countries have been setting goals that strive to reach environmental sustainability. For example a study conducted in Melbourne determined that the average person used 500 litres of water in 1981 and in 2007 the average person only used 277 litres of water (Melbourne Water, 2010). The goal established in Melbourne in 2009 strives to decrease this number further to 155 litres per Melbournian per day (Victoria Government Department of Sustainability and Environment, 2009). This study shows that the per capita water consumption was nearly cut in half within 26 years. Sustainable construction practises,

materials and equipment are being implemented in order to strive for environmental sustainability.

2.2 Sustainability in Construction

Sustainable construction practises are used to strive to achieve environmental sustainability. Sustainable construction consists of multiple components that address ways to improve energy consumption, water use, and air quality within a building by incorporating sustainable materials, structures, and other practises. These topics are carefully considered when designing and constructing a sustainable building. Sustainable construction is assessed with the Green Star rating system in Australia. Although getting Green Star accreditation is costly, its sustainable principles can still be used in construction projects that do not receive accreditation. More information about Green Star Accreditation can be found in Appendix B.

2.2.1 Sustainable Energy Consumption

Current energy systems are not sustainable and will not be able to support future energy needs. Sustainable practises and developments are now being considered and implemented. Sustainable energy practises like using solar energy, sustainable or natural lighting and efficient insulation are some solutions to the energy consumption that threatens our future needs and environment.

Solar Energy

More energy from sunlight strikes the Earth in one hour than all the energy consumed by humans in an entire year. On a bright, sunny day, the sun's rays emit approximately 1,000 watts of energy per square meter of the planet's surface (Toothman & Aldous, 2000). If only a fraction of this energy is harvested, homes and offices can be affordably powered in an environmentally friendly manner. With increasing attention toward alternatives, solar electricity is receiving greater consideration as a potentially widespread solution to sustainable energy production.

There are three types of solar panels, photovoltaic, thermal and photovoltaic thermal. Photovoltaic solar panels (PV) convert sunlight directly into electricity using the photovoltaic

effect. This effect causes materials to absorb photons of light and release electrons (Knier, 2002). Figure 3 illustrates the basic concept of the PV panel. PV panels absorb up to 80% of solar radiation but only convert 5-20% of this energy into electricity and the rest is transformed into heat.

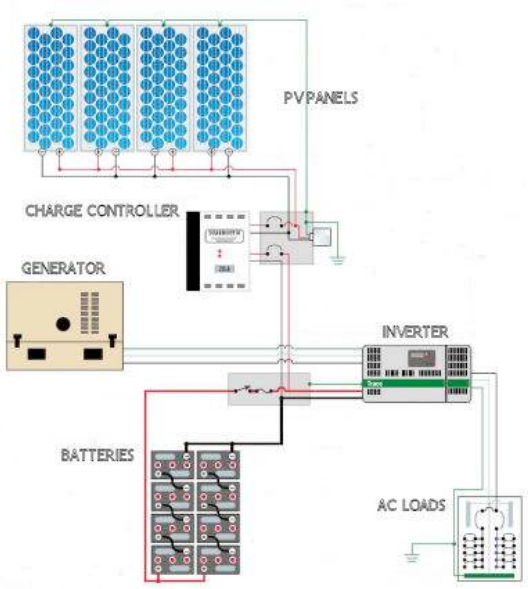

Figure 3: Photovoltaic Panel (How Do Photovoltaic Panels Really Work, (2009)

Thermal panels have black absorbers that are heated by solar irradiance, and then a medium, like water, extracts this heat and uses it for water or space heating. Figure 4 shows how the thermal panel works. Thermal panels are generally less expensive and larger than PV panels. The efficiency of these panels depends on the heat of the sun because these panels are generally used for domestic uses such as heating hot water, not generating electricity (Burley, 2009).

Photovoltaic thermal panels (PVT) combine the functions of the photovoltaic panel and the thermal panel (Rindt, Santbergen & Zolingen, 2005). PV panels are much more practical than thermal panels, but they still do not have a huge collection rate. In PVT panels, the heat from the thermal panel is collected and used to heat the building while the energy is converted to electricity, thus utilising more of the energy output of the panel (Helden, Zolingen & Zondag, 2004).

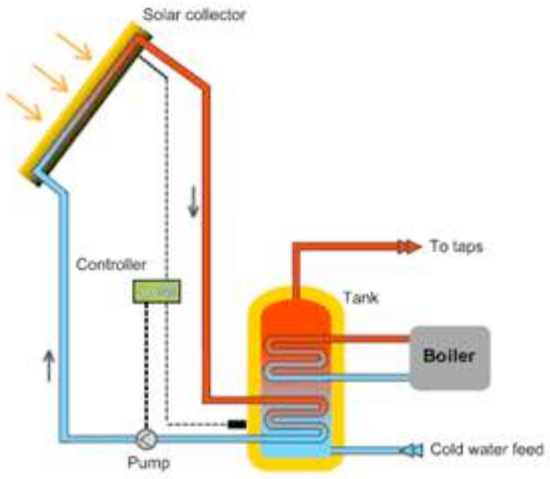

Figure 4: Thermal Panel (Solar Power, 2010)

Sustainable Lighting

Use of natural light and efficient lighting structures can substantially reduce the amount of energy consumed for illumination in buildings and have a significant effect on building occupants. In the 1960s, buildings were designed with windows made of black glass or no windows at all; therefore they had very little natural lighting. These buildings were made like this in order to increase security, allow air conditioning to be more efficient, reduce maintenance costs and diminish external noise (Olson & Kellum, 2003). Recently, energy and environmental concerns have made day-lighting a rediscovered aspect of building lighting design. During the 1990s, building designs began to allow more natural lighting, by using skylights, baffles, roof monitors, and clerestory structures. Studies have shown that schools with limited natural light suppress the learning capacity of students. Students who attend a "maximum day-lighting school" generally test higher, learn at an accelerated rate, and attend classes more frequently (Olson & Kellum, 2003). In addition natural sunlight can soothe nerves allowing the brain to make more endorphins, hormones that make people feel happy (Natural Health Restored, 2010). The benefits of natural lighting are also noticeable in the office. Occupants in day-lit office buildings reported an increase in general well being. Specific benefits in these types of office environments include better health, reduced absenteeism, increased productivity, and preference of workers. Benefits to the office worker are so great that many

countries in Europe require that workers be within eight metres of a window (Edwards & Torcellini, 2002). Therefore, not only do students and employees positively benefit from natural lighting, but incorporating natural lighting in building designs can save between 30% and 70% of energy consumption (Olson & Kellum, 2003).

When constructing a new sustainable building, orienting a building properly can maximise the amount of natural light the building receives throughout the course of the day. Orienting a building with more, larger windows, for natural sun lighting assists in making the building sustainable. The face of the building with the larger windows depends on the construction location. Situating larger windows to face towards the equator exposes the building to the most direct sun light for the longest period of time, effectively maximising the amount of light entering the building (Lee, 2011). Consequently, on a clear day the building is sufficiently lit without the use of electricity, which reduces energy consumption and costs significantly. Nevertheless, there are disadvantages to this passive design principle. Maximising the building's exposure to sunlight can increase the amount of heat transfer between the inside and outside of the building. In the extreme temperatures of the winter and summer months, windows can actually increase energy consumption and costs through excessive heating and cooling. To mitigate heat transfer, using glazed windows and sunshades can lower both lighting and heating or cooling costs; these concepts are further explained in *Efficient Insulation and Window Alterations* (Wright, 2005).

In buildings that have limited access to natural light due to location or operation hours, it is important to incorporate efficient light structures within the building to reduce energy consumption. Some structures that can be included are fluorescent or halogen light bulbs rather than incandescent light bulbs, and motion sensors that turn the lights on and off when motion is detected in the room. Fluorescent light bulbs use about 75% less energy, produce 75% less heat, and last ten times longer than standard incandescent bulbs. A fluorescent light bulb can actually save more than USD$40 in electricity costs over its lifetime (United States Environmental Protection Agency (EPA), 2010). Additionally, according to Energy Star, if every

American home replaced one incandescent light with a fluorescent, the energy saved could light three million homes for a year, save about USD$600 million in annual energy costs, and prevent nine billion pounds of greenhouse gas emissions per year, equivalent to those from about 800,000 cars (United States EPA, 2010). Halogen light bulbs are similar to incandescent light bulbs because they both use tungsten filament. However, incandescent light bulbs are inefficient because they waste heat energy. Halogen light bulbs, on the other hand, use a heat recycling process that causes the filament to last longer and create more light per unit of energy (HowStuffWorks, 2000). Motion sensing lighting systems turn lights on and off when motion is or is not detected in a room thus, light will only be used when it is necessary and energy will not be wasted.

Efficient Insulation

The processes of heating, lighting and cooling account for nearly 40% of the total global energy consumed yearly, with the greatest consumer being heat (Papadopoulos & Giama, 2006). In the last three decades, impressive progress has been made to mitigate the amount of energy consumed to heat and cool buildings by using enhanced thermal protection. In 1975, German building codes increased their thermal insulation thickness for new construction from five to twenty centimetres. As a result, the average annual consumption was reduced from 300-kilowatt hour per square meter of living area (kWh/m^2a) in 1970 to 50 kWh/m^2a in 2006 (Papadopoulos & Giama, 2006). These more energy efficient buildings reduce the quantity of fossil fuels consumed and thereby reduces the amount of carbon dioxide and sulphur dioxide emitted into the atmosphere.

To significantly minimise building energy consumption, contractors and designers must thermally protect the shell of the building with insulating materials. The most widely used categories of insulating materials include inorganic fibrous (glass wool and stone wool) and organic foam (expanded and extruded polystyrene) (Papadopoulos & Giama, 2006). These materials are designed to lower the heat transfer between the inside of a building and the outside environment. They retain heat in buildings during the winter months and keep

relatively cool air inside during the hot summer months. Insulation can save natural resources like fuel; in just one year glass wool insulation in an average home saves the fuel equivalent to 8760 litres of petrol which is enough to drive a typical car around the world twice (Knauf Insulation, 2003).

Despite the fact that these materials may be considered sustainable because they reduce energy consumption for heating and cooling, there are numerous, alternative insulating materials that are considered much "greener." These materials, such as recycled newspaper, recycled denim, and hemp fibres, are not only sufficient insulators but are made from recycled or environmentally friendly materials. For further information regarding green insulation refer to Appendix D (Green Home Guide Staff, 2009). Using materials with good insulating properties in commercial and residential buildings can reduce energy consumption.

Although windows allow light to enter buildings, which can decrease the use of energy, more windows can increase the amount of heat transfer between the outside and inside of the building. Sixty percent of heat loss in homes occurs through single paned windows (First Glass Double Glazing, 2011). To combat this problem, glazes can be applied to windows to allow various amounts of light and heat to pass through the windows (Means, 2002). Historically, windows were single glazed, with a single pane of glass. Today, there are a number of options for window glazing. Double or triple glazed windows have better insulating properties than a single pane of glass, making a structure more energy efficient by reducing heat transfer through the windows. Glass can also be tinted to keep sunlight out, coated in a clear film to increase energy efficiency, and otherwise treated to make windows more thermally efficient. As an incentive to improve home energy efficiency, energy efficient windows are subsidised by utilities or the government in some regions (Australian Government: Department of Sustainability, Environment, Water, Pollution and Communities, 2011). Glazed windows decrease the amount of energy consumed to light and heat or cool a building by allowing natural light in, while also reducing the amount of heat transfer between the building and outdoors (Smith, 2010).

2.2.2 Sustainable Water Consumption

Water efficiency is an important issue to address when designing sustainable buildings. Water efficiency is especially important to Australians; due to their frequent droughts there is a limited water supply. Two efficient ways to conserve water are the use of dual flush toilets and the capturing of storm water (White & Fane, 2007). Dual flush toilets have different settings depending on the type of excretion. Liquid excretion has a setting that sends half the amount of water down the toilet than solid excretion (Elliott, 2010). A study conducted in Sydney in 2001 shows that changing from standard toilets that use between 11 and 13 litres of water per flush, to three to six litre dual flush toilets reduced the average amount of daily toilet water used per person by 20 litres (White & Fane, 2001).

Rainwater can be easily collected through rooftop runoffs and used for numerous purposes. The runoff water can be used for watering gardens, cleaning, toilet water, and many other purposes (Means, 2002; Worm & van Hattum, 2006). The collection of storm water is "the single most significant way to preserve water for the future," and can lower consumption of water from the public water supply by 40% (Means, 2002, 82). The easiest way to harvest rainwater is to collect it off of a roof and transport it through a drainpipe into a holding tank where it can be stored until needed (Worm & van Hattum, 2006). Figure 5 illustrates the process of using a rainwater storage tank.

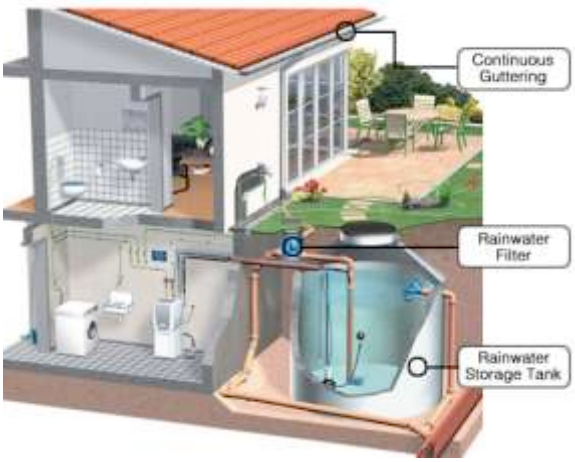

Figure 5: Water Harvesting System (Babcock, 2010)

Rainwater storage tanks are a sound investment when a building is undergoing its initial construction because the tanks can be linked into the plumbing, so that the rainwater can be used as toilet water.

2.2.3 Sustainable Materials

Incorporating recycled and reused materials in building construction also makes the building more sustainable. Construction materials that can be made from 100% recycled materials include sheathing, drain pipes, and shelves (Means, 2002). Sheathing is a thin sheet of wood that can be used as a layer in floors, ceilings, and interior and exterior walls (Dagostino, & Peterson, 2010). It can be made from recycled wood fibres or sawmill waste. Not only is sheathing made from 100% recycled materials, but after it has been used it is still 99% recyclable. Nevertheless, it is sometimes bonded together with glue that contains urea-formaldehyde, which may cause health issues including coughing, watery eyes, eye, skin and throat irritation, and may also be a cause of cancer to both animals and humans. Therefore when looking into different types of sheathing, checking the adhesives used in the sheathing is important (Chiras, 2000; U. S. EPA, 2010).

A variety of building elements, such as drainpipes and shelves, can be made from down-cycled plastic bottles. Down-cycled materials are materials that cannot be recycled again. Therefore, the drainpipes and shelves are considered sustainable since they are manufactured from recycled materials, but they cannot be re-recycled (Means, 2002; Mickey, 2011).

Another eco-friendly resource is bamboo. Bamboo is eco-friendly because 30% of its biomass is replaced in a year, in comparison to a tree forest that can only replace 3-5% of its biomass in the same time frame. Therefore, a bamboo plant can reproduce mature fibres within three and a half years, while it takes other trees 50 to 60 years (Steinfeld, 2001). Some species of bamboo can even grow four feet in 24 hours (Cali Bamboo, 2010). Bamboo is used for many different aspects of construction such as flooring, stair treads, furniture, and panelling. It is not only used because it is eco-friendly, but also because it is 23% more durable than oak, and 13% more durable than rock maple (Steinfeld, 2001).

2.2.4 Sustainable Alterations to Homes

In the past, Australian houses were usually designed and built with the assumption that many resources including energy, water, and fuels would always be plentiful and easily accessible. With few exceptions, this practise continues to be reflected in new home construction. However, simple, sustainable improvements can be made to existing houses that can reduce greenhouse gas emission, energy consumption rates, and cost (Wrigley, 2005).

Window Alterations

Improvements such as adding curtains or blinds, adjustable sunshades, sun reflectors, and landscaping properly around windows can help reduce energy consumption, and cost. The correct placement of blinds, curtains, sunshades, and sun reflectors can assist in the heating and cooling of the house (Wrigley, 2005).

Blinds are effective by allowing the sun's heat to enter to warm the house when it is cold or keeping the sun's heat out during the summer. They can be adjusted based on the angle of the sun and the amount of light and heat needed to pass through (Wrigley, 2005).

Curtains can help keep the warm air inside during the winter months. Without curtains, heat transfer occurs through the window. The cold from outside is conducted through the window and the air circulation in the room takes this cold and moves it through the bottom of the room. The heat that was there before is pushed up to the ceiling and the heat is conducted back through the window's glass. Having curtains cover the tops of the windows can block circulation and keep the warm air inside houses (Wrigley, 2005).

Adjustable sunshades are a simple, affordable, and low maintenance sustainable feature that can also be implemented to offset cooling costs, but they can still allow for an abundance of natural light. To construct a sunshade, only a few pieces of timber for a frame and a shade cloth such as Coolaroo are needed (Gale Pacific, 2006). Coolaroo's white knitted construction, as opposed to a woven construction, enables it to keep out about 95% of the heat while enhancing daylight penetration by refracting the light. The unique fabric also allows rain to pass through; keeping foliage underneath the shade watered, and breathes sufficiently to prevent it from

flapping in the wind. In the autumn, when the hot days have finished the shade should be moved to approximately 45° above the horizontal to allow the warming sun to penetrate the interior (Wrigley, 2005).

Additional, but less efficient, ways to retrofit shades include opaque materials and awnings. Opaque materials create a substantial amount of shade, letting little to none of the sun's rays through; in some cases, such as metallic blinds, they can actually reflect heat and light away from the building. However, opaque blinds make the inside of the building quite dark and heavily reliant on electricity. Also, most awnings are not effective at keeping out the hot low-angled sun in the morning and afternoon because of the angle they hang off the wall (Wrigley, 2005).

Proper landscaping outside of a house can also save energy by keeping it cool or warming it. Plantings in areas that block windows can help shade the house and keep the hot sun from warming the house. Additionally, because deciduous trees lose their leaves during the winter months, sunlight that is normally blocked during the summer can enter the house in the winter and assist in warming the house (Wrigley, 2005).

Alterations to Improve Air Quality

When constructing and furnishing a building, the quality of the materials that are put in the building can be a key factor for reducing indoor pollutants and producing an environmentally sustainable building. A study shows that Australians spend 90% of their time indoors (Australian Government: Department of Sustainability, Environment, Water, Population and Communities, 2011). Therefore it is crucial to have healthy indoor air quality.

Poor indoor air quality can cause sick-building syndrome (SBS). SBS is a condition characterised by headaches, fatigue, and respiratory problems cause by stressful work environments such as poor ventilation (Olson, 2003). The main cause of SBS is due to volatile organic compounds (VOCs). VOCs are organic chemicals, which become increasingly dangerous and can be highly toxic when they are emitted into an area at room temperature (Wolverton, 1997). These organic chemicals include benzene, formaldehyde, and trichloroethylene (Clean

Air Plants & Sick Building Syndrome, 2011). These toxins can be created from many products, including office appliances, furniture, carpets, cleaning agents and fixtures (Wolverton, 1997).

Currently, many pollutants differing in chemical composition, reaction properties, emission, persistence in the environment, and their impacts on human and/or animal health are being emitted into the environment. Humans are exposed to these chemicals and pollutants constantly through inhalation, ingestion and dermal contact. Adverse health effects from these pollutants mainly affect the cardiovascular and respiratory systems (Kampa & Castanas, 2007).

Luckily, there are many construction practises that can be used to reduce toxic pollutants. These practises include building or renovating units using timber products that are certified for low formaldehyde emissions, furnishing the unit with furniture certified for low VOC emissions, and using paints that have low VOC levels (National Asthma Council Australia, 2005). A study conducted at the University of Technology, Sydney (UTS) stated that green plants are an efficient way to lower the amount of VOCs. Plants help remove dust from the air, and help cool the air through evapotranspiration[1]. Some plants that grow well in indoor environments include ivy and palms.

Experts say that the chemicals expelled from heating and cooling units could be another contributor to SBS (Causes of Sick Building Syndrome, 2011). One way to reduce the use of heating and cooling units is through the use of ceiling fans. Ceiling fans can be adjusted to spin in different directions depending on whether occupants desire to heat or cool the room (Mifflin, 2011). In the cold winter months, adjusting ceiling fans to spin in a clockwise direction will draw the cool air up towards the ceiling push hot air down the walls towards the floor (Whiteley, 2011). This motion of air circulation helps create a warmer atmosphere. During the hot summer months, ceiling fans can be changed to spin in a counter clockwise direction, forcing the air downward and effectively cooling the room (Mifflin, 2011).

[1] Evapotranspiration is the movement of water through the plant and into the atmosphere. Water starts in the soil, and then is consumed by the plants roots, where it works its way through the plant and eventually exits the plant and into the atmosphere (Ambius, 2011).

2.3 Practises in Sustainability

Sustainable construction and sustainable materials can help the environment, but can be costly and are usually not implemented unless an individual is financially committed to remodelling or constructing a building. Nevertheless, there are other no-cost practises that can be implemented into everyday life that can also help the environment. Practises such as recycling, composting, and gardening can reduce our environmental footprint by diminishing solid waste and reducing energy use.

2.3.1 Recycling

Recycling is the reuse or reprocessing of products in order to create new ones and reduce waste. The term recycling originated four decades ago from a United States paper company that wanted to create a symbol to show the products contained reprocessed content. Gary Anderson's design of a shape with no end, a mobius shape, is now universally known as the recycling symbol; see Figure 6 (Planet Green, 2009). Recycling materials creates new, useful products that can function as well as those made with virgin materials and also reduce the amount of solid waste that would need to be processed or sent to landfills (United States EPA, 2010). Useful products like cups, paper, and construction materials can be made from recycled goods (Planet Green, 2009). Reducing the amount of waste in the world and reusing resources instead of depleting natural resources further can help the environment greatly. Recycling plastics to create new plastics uses 30% less energy than creating plastics from raw materials, and the energy saved from recycling one aluminium can is enough to power a television for three hours (Benefits of Recycling, 2010).

Figure 6: Recycling Symbol (Planet Green, 2009)

Germany is an industrial nation with limited land for landfills. They have been raising the standard for recycling for many years. The Toepfer Decree was implemented to reduce the amount of plastics being put into landfills. This decree requires packaging companies to take back plastic packaging from their consumers and reuse these plastics or dispose of them in an environmentally sustainable manner (Reynolds, 1995). The Dual System Deutschland Corporation (DSD) was created as to help packaging companies follow the Toepfer Decree. The DSD collects and disposes of packaging for the packaging companies for a small fee. If companies are DSD certified, their packaging contains the materials the DSD claims to be reusable or recyclable; the green dot symbol is placed on the packaging, which can be deposited in bins throughout the country, see Figure 7 (Reynolds, 1995).

Figure 7: German Green Dot Symbol (Reynolds, 1995)

Following Germany's lead, other countries have introduced different recycling collection schemes. There are two main ways of collecting recycling, "kerbside" collection and "bring-schemes". Kerbside pickup is a method where recyclable objects are placed in bins on the kerb

where it is picked up, sorted, and sent to other facilities to be re-used. Ninety percent of Australians have access to this collection scheme, making it an easy method that requires minimal work for participants (Department of Climate Change and Energy and Efficiency, 2010). Bring-schemes require participants to bring their recycling to a specified place to be picked up. Many local authorities and supermarkets in the United Kingdom are known as "bring banks" and some even have "reverse vending machines" (Hopewell, Dvorak & Kosior 2009). While not all materials can be recycled, some can still be disposed in an environmentally friendly way by composting.

2.3.2 Composting

Composting can be used to reduce the amount of solid waste in a landfill. It is an easy environmentally sustainable alternative to landfills and trash collection. The compost created with "trash" can be used to fertilise lawns or gardens and does not contain harmful chemicals like other fertilisers. This trash includes organic materials like fruits, vegetables, saw dust, leaves, grass and cornstalks. About half of landfill waste is organic material that produces landfill gas, known as methane, which is even more damaging to the environment than carbon dioxide (Department of Climate Change and Energy and Efficiency, 2010). These organic materials can easily be composted instead of harming the environment with landfill gas. There are two types of composting, hot and cold. Cold composting is what occurs in forests and can take years to decompose. Hot composting generally occurs in household composting bins and takes several weeks to create compost (The Garden of Oz, 2009).

Compost contains essential nutrients for plants and soil. Compost slowly releases its nutrients so plants have a steady intake of essential nutrients, which is important for growth. Compost even improves plant strength and can help with plant immunity from diseases (The Garden of Oz, 2009). To learn more about composting, see Appendix C.

2.3.3 Community Gardens

Community gardens can have a positive effect on the environment by decreasing the distance food is shipped and the fuel necessary shipping, and reducing the amount of materials

used for packaging while also engaging and immersing the community in sustainable practises (Twiss et al., 2003). The reduction in shipping and fuel because of community gardens can be seen through food miles. Food miles are the distance between where the product is consumed and where it is produced. In order to calculate these miles, a weighted average source distance (WASD) equation is used. The formula is shown in Figure 8.

$$WASD = \frac{\Sigma\left(m(k) \times d(k)\right)}{\Sigma\left(m(k)\right)}$$

Figure 8: Equation for Calculating Weighted Average Source Distance [Food Miles] (Pirog, 2003)

The symbol *k* stands for the location of food production, *m* stands for the weight or amount of food from each place of production, and *d* stands for the distance from the point of production to each point of use (Pirog, 2003). Food miles can be reduced drastically with the help of community gardens.

According to a case study in southeast Toronto, there are many other benefits to the community gardens in addition to reducing food miles. Gardeners stated they had "improved access to food, improved nutrition, increased physical activity and improved mental health" (Wakefield et al., 2007). Through the community garden, gardeners said they improved their "social ties" with their community, which incidentally improved their feelings of security and safety within the community (Wakefield et al., 2007). In addition, their awareness and understanding for social diversity also improved and many stated saving money by growing their food as opposed to buying it. Some of the gardeners in the study were immigrants and were able to grow vegetables native to their home countries. Since imported vegetables are more expensive in stores it is understandable that gardeners were able to save money while still eating their cultural foods (Wakefield et al., 2007).

2.3.4 Transportation

Transportation is a part of everyday life; people travel to work, school or home each day. In Australia, in 2005, there were over 13.9 million cars, trucks and buses and 80% of those were passenger cars (Li et al., 2009). In 2010, it was reported that transportation emissions are

responsible for 14% of Australia's net greenhouse gas emissions (Australian Bureau of Statistics, 2008). This amount of emission can easily be reduced through public transportation, carpooling, walking or biking. Public transportation not only reduces emissions, but also eases congestion and allows for a relaxed ride to work instead of dealing with traffic and road rage (Planet Green, 2009). It is easy to plan out a public transit route to limit car usage. Planning out a route through websites such as Google Transit or using city public transit systems like Melbourne's MetLink, are also useful practises (Planet Green, 2010).

The governments in other countries are also trying to cut back on their national car emissions. Countries like Denmark have paved pathways for bicyclists and raised roadways for them on major roads in Copenhagen. There are many places to rent a bike on the street and drivers in Copenhagen are very conscious of the bicyclists on the road because they themselves are bicyclists. With all the new bike pathways and other features the city is constructing, the Danes aim to have 50% of commuting done by bike by 2015, which will lower annual carbon dioxide emissions by 80,000 tonnes (Videos about Denmark, 2010).

Melbourne has created their new bicycle plan, based on the Danish model, that they started implementing in 2007. The city's aim is to create "a transport network which is convenient, equitable and sustainable, ensuring a thriving and sustainable City, and which meets the diverse needs of our residents, workers, tourists, visitors and businesses" (City of Melbourne, 2011). The Melbourne Bike Share offers a new form of public transportation for short trips through the city. Bikes can be rented daily, weekly or yearly and helmets can be purchased at 7Eleven convenience stores for five dollars. There are 600 bikes and 50 bike stations located around the Melbourne CBD allowing for convenient bike drop off and pick up (State Government Victoria, 2010). The city has also been constantly adding new bike paths on and off-road. Sixteen kilometres of on-road cycling paths and eight kilometres of off-road paths were constructed between 2002 and 2007 (City of Melbourne, 2011). The bike paths in the city have been upgrade and their pavement colour changed and new signs have been put into place to make biking throughout the city safer. With all these new improvements bike use has become

more popular. A study in 2004 stated that 3,438 cyclists entered the city between 7.30 am and 9.30am and in 2006 the study showed there were more than 4000 bicyclists (City of Melbourne, 2011).

2.3.5 Other Sustainable Practises

Recycling and composting are two ways to become more environmentally sustainable through managing waste. However, energy and water management is also important. There are many daily practises that can be employed to save energy. Instead of using a dishwasher drying cycle or clothes dryer, dishes and clothes can be air-dried. Additionally, waiting for the washer to be full of dishes or clothes and taking shorter showers can reduce the amount of water and energy used (United States Department of Energy, 2010). Washing windows and lights with natural ingredients including vinegar, baking soda and lemon juice is a good way to prevent polluting the air with typical household cleaners and save water (Craven, 2003). Turning off electrical appliances and power strips when they are not in use will also reduce energy use. Electronics that are plugged into outlets but are on standby still consume energy and can add up to 10% of an electricity bill. Also, when buying new appliances, consumers should look for the energy-rating label. This label gives a simple rating of the energy efficiency of the appliance as well as an estimate of how much energy the appliance uses per year. When shopping, consumers should remember to bring re-usable bags and refuse extra plastic bags; this can reduce the energy used to make the plastic bags as well as the material resources (Department of Climate Change and Energy and Efficiency, 2010). These simple everyday practises can help save a substantial amount of energy, water and the environment.

2.4 Empowerment Through Environmental Education

Since our main goal was to educate and empower people to adopt a sustainable attitude, we must first establish a strong sense of awareness and motivation for the environment. Environmental education is an approach designed to educate people about how the environment is linked to societal and economical actions. The definition of environmental education has evolved to including a way to develop peoples' minds to critically think and act in

a sustainable manner (Tilbury, 2006). The primary goal of environmental education is to create pro-environmental attitudes by addressing the concerns derived from unsustainable and wasteful practises and proposing ways to help reduce their effects (Pooley & O'Connor, 2000). However, motivation is a key factor in the process of behaviour change. By identifying the specific issues in the Broadmeadows community and determining possible solutions, it is possible to encourage and uphold positive attitudes toward environmental sustainability.

2.4.1 Community-Based Education and Motivation

As a community, the sense of unity and a support system assist its members in upholding sustainable behaviours. Community-based approaches in environmental education also focus on unifying communities of similar place, identity or interest, as opposed to a classroom community. The goals of community-based environmental education involve behaviour change and contextualising the economical, political and social reality of the community (Dietz, 2002). The National Environmental Education Council of Australia, comprised of environmental education experts and distinguished community leaders, believes that educating communities about the issues of environmental sustainability is just as important as teaching about social and economic issues (Environment Australia, 2009). This National Action Plan recognises that informal education is critical for lifelong learning and community involvement. The development of programs has ranged from instructive programming, which solely provides information, to engaging programs that are more interactive and strengthen community relationships (Tilbury, 2004). In schools, student environmental education programs collaborate with the local community develop projects that require students to be more active and involved directly in the workplaces and environmental surroundings (Cloud, 2005). Learning and adapting sustainable practises as a community is more empowering because the addressed issues directly affect the local community. Its members "take responsibility and action for their own 'backyard'" (Cuthill, 2002, p. 79).

One study that was conducted over a two-year period in Queensland, implemented, observed and interpreted the results of community-based research. The basis of this research

was to examine the reaction and cooperativeness of the local community to regulate and improve the condition of "local socioecological systems," or the effects of their harmful interactions with the environment, through experiential and social learning and action. From this research, conclusions were also made that community-based education fostered positive social interactions, which in turn encouraged participation in sustainable actions (Thomsen, 2008). Therefore, educating the public in a community-based manner is a beneficial way to promote positive environmental behaviours as well as increase social interactions and better community dynamic.

Community Education at Banksia Gardens Community Centre

Broadmeadows is comprised of a diverse range of people who uphold and value a strong, connected and inclusive community. This feature is what makes Banksia stand out as a successful community centre. Banksia Gardens created a series of Eco-Warrior Projects that focus on educating the local community about the issues concerning environmental sustainability and implementing beneficial sustainable practises for the community. The projects involve working with local residents, schools, and businesses "to deliver sustainable outcomes that are beneficial and meaningful to the local community" (Banksia Gardens Community Centre, 2010). In addition to the Eco-Warrior Projects, Banksia Gardens also offers a spectrum of programs that engage people over a wide range of ages. After school programs include dancing, art workshops, music, athletics, and excursions. Other programs include cultural diversity programs, women's support groups, and community garden activities that aim to engage older members of the community. Through participating in these constructive programs, the residents who live in Broadmeadows are able to develop strong, supportive relations, which help enhance the greater community.

2.4.2 Early Education for Environmental Sustainability

In addition to educating and empowering a community, many experts conclude that it is essential for practises in environmental sustainability to be introduced at a young age. Environmental education is a lifelong process that begins in early childhood, and it is important

that sustainable practises are conditioned into young minds at an early age (Elliot, 2010). There is much concern about environmental welfare in the future due to contemporary conditions and practises. As the population increases, levels of energy and resource consumption have increased to meet the high demands for quality of life (Davis, 1998). Many organisations and governments are taking note of this issue and are developing solutions to prepare the future generations with the tools to better the world. Education sectors including elementary, secondary and tertiary, have been making efforts to raise awareness and teach about environmental sustainability for more than thirty years (Elliot & Davis, 2009).

It is particularly effective to start environmental and sustainable education at a young age. Sue Elliot, the leader of the Australian Association for Environmental Education Early Childhood Special Interest Group and a lecturer at RMIT University, believes that introducing environmental sustainability practises to children will help them think more sustainably and inform them about how their actions affect the environment (Elliot, 2010). This mind shift will be very beneficial for the future because it will generate a culture centred on being sustainable (Elliot, 2010). Currently, numerous grade school curricula integrate units to teach about environmental issues and introduce practises to save the environment. The Australian Department of Sustainability has suggested a framework to organise an environmental education program in the Australian school curriculum. This framework involves teaching sections about, in and for the environment. Education *about* the environment concentrates on teaching students important facts, concepts and theories of environmental sustainability. Education *in* the environment engages students in learning directly in the environment, and education *for* the environment seeks to inspire students to adopt sustainable practises (Cloud, 2005). One segment of the Australian Curriculum focuses on using science to influence and teach secondary school students about sustainable practises within an ecosystem. Curriculum topics include water management, recycling of water, and recognition of the effects of human activities on the sustainability of the ecosystem (The Australian Curriculum, 2010).

2.4.3 Twenty-First Century Education for Environmental Sustainability

Not only is it important to educate people about environmental sustainability at a young age, it is also important to educate the current adult populations about it. One important reason for educating adults about sustainability is that it sets a positive model for younger generations to follow. Since a culture centred on environmental sustainability is critical for the future, adults must incorporate good environmental practises into their daily routines to instil a sustainable mindset and act as a positive role model for younger generations. By presenting and giving examples of good adult role models, teachers found it effective and influential when teaching their students about environmental education (Ernst, 2007). Setting a good example will lead to positive behaviour change.

In addition to helping the future, educating the public about environmental sustainability is also beneficial for today's society. The contemporary adult life is mainly driven by economics. Adults work to make a living and support a family. However, the economic aspects of people's lives are greatly affected by current environmental concerns, high demanding lifestyles and capitalism. In today's society, many people conform to capitalistic globalisation trends, such as using car petrol and heating and cooling units. These actions feed the monopoly of these capitalistic companies, which results in people ignoring environmental concerns and taking advantage of the environment. Therefore, the main causes of the environmental issues are from practicing capitalism (Clover, 2003). However, if adults diverge from these monopolistic practises, become aware of the people who are affected by these detriments, and begin to gear their mind to think about being more sustainable, the effects will be tremendously beneficial for conserving the environment. Essentially, environmental adult education is most effective in a community based setting.

2.5 Environmental Education for Different Learning Styles

There are many teaching techniques that are tailored to different learning styles as well as diverse learning environments. Studies have shown that young children learn better through engaging and hands-on activities, whereas adults tend to prefer self-directed learning.

2.5.1 Teaching Through Hands-on Activities

For environmental education, "fostering active learning and encouraging personal interactions" lead to personal curiosities and need to know, which then leads to positive behaviour change (Armstrong, 2005, p. 234). Especially with young children, who are naturally energetic, learner-centred teaching techniques, such as hands-on and engaging activities, will enable them to embrace and absorb all the content (Cloud, 2005).

One study conducted at the University of Louisiana at Lafayette, determined that hands-on activities increased middle school students' interest in agricultural and environmental issues. The study also found that the program taught critical thinking skills to the students and enabled them to assist the local community in alleviating agricultural and environmental issues in the area (Poudel et al., 2005).

Another program conducted in Puerto Rico enhanced environmental awareness through creating elementary school programs that collaborated with the local community. This program promoted cooperative and active learning by requiring the children to work together as well as with the community organisations. Students conducted research in the community that addressed local waste management and water resourcing issues. This study concluded that the "implementation of hands-on and minds-on activities" increased students' interest in environmental science (Rivera-Rentas et al., 2007).

2.5.2 Educating Through Self-Directed Learning

Self-directed learning is one model that usually distinguishes adult learners from children. It is an educational approach that "recognises the significant role of motivation and volition in initiating and maintaining learners' efforts" (Abdullah, 2001). This model can occur in a formal learning environment or naturally as a part of an adult's daily life. To the matured mind, having the ability to select the information it wants to learn gives the being a sense of power (Merriam, 2001). It is important to give adults that sense of control so they are more apt to learn because they want to rather than associate environmental learning as a task. Many benefits foster from self-directed learning; it hones adults' abilities to learn through self-

direction, it promotes “emancipatory learning and social action”, and it transforms the adult mind to think more critically about how various factors relate to oneself (Merriam, 2001, p. 9). Also, since self-directed learning, surprisingly, is highly collaborative, it improves social relationships (Abdullah, 2001). Therefore, self-directed learning is an effective way for adults to learn about environmental sustainability.

2.5.3 Learning Styles Inventory

Everyone has a preferred way of learning and everyone uses both their right and left-brain hemisphere to process information. Most individuals use one side of their brain more than the other, meaning learning certain subjects are easier than others. There are three main styles of learning based on the side of the brain and learning style that is most progressed, kinaesthetic (doing), audio (hearing), and visual (seeing) (Brown, 2011). Kinaesthetic learners understand the material the best when fully involved in the activity. Learning through labs, skits, field trips, dance or other activities allows kinaesthetic learners to understand the material the fastest (Farwell, 2011). Auditory learners interpret knowledge through traditional teaching techniques like lectures. Visual learners understand information through pictures, films, diagrams, and written directions (Farwell, 2011). About 20% to 30% of individuals in school retain what they hear, 40% can visually remember material read or seen, and others need to be fully engaged in real-life activities to learn (Farwell, 2011).

2.6 Summary

Due to the increasing concerns about climate change, environmental sustainability, and the Earth’s future, communities around the world have been implementing ways to strive towards a culture that centres on environmental sustainability. Through the Eco-Warriors Projects, Banksia Gardens Community Centre seeks to educate and empower the Broadmeadows community to start taking action. Our research to familiarise ourselves with the causes and effects of climate change, sustainable construction, sustainable practises, and methods to empower and effectively communicate to a diverse audience through environmental

education has enabled us to identify strategies to develop an interactive and attractive program for the Banksia Gardens Community Centre to motivate the community.

3.0 Methodology

The challenge of our project was to educate the Broadmeadows community about environmental sustainability, and empower and encourage them to participate in sustainable practises. Through displays and activities presented throughout the community centre and especially within the new, sustainable classroom, we concentrated on educating the centre's visitors about the importance of environmental sustainability. We developed activities that accommodated people with different levels of interest and knowledge. To accomplish these goals, we worked with our liaisons and other staff members at the Banksia Gardens Community Centre and environmental educators to address the following objectives:

- To assess the community's interest and knowledge level in environmental sustainability.
- To identify the sustainable features at the community centre and the new classroom; as well as, sustainable features in other sustainable buildings.
- To design and determine the best-suited displays and activities to develop that engage the Broadmeadows community.
- To create interactive and educational displays and activities about the new classroom and sustainability to place throughout the centre to act as tools to engage and teach the members and visitors about sustainability in construction and simple practises.
- To assess the success of the interactive and educational displays and activities and provide suggestions to the centre for future projects.

To achieve these objectives, we used qualitative approaches such as participant and direct observations, interviews, tours and surveys to gather information to help us complete our project.

3.1 Laying a Foundation: Determining Interests and Knowledge

Our first objective required us to obtain a solid foundation for our project by gaining a good understanding of the community's background and their interest and knowledge levels about environmental sustainability. We needed to understand how their backgrounds affected

the types of displays and activities we create. The information also helped us identify the criteria we used to select the displays and activities. Essentially, this objective laid the groundwork for our project and many components of the project depended on the information we gathered. We fulfilled this objective with direct participation, observations, informal interviews of our target community and interviews with Banksia Gardens Community Centre staff members.

3.1.1 Direct Participation and Observations of Youth and Community

We arrived at the project site during the summer holidays; therefore we observed and directly participated with a sample of the Broadmeadows youth who were enrolled in Banksia Gardens Community Centre holiday programs. We attended three holiday programs between the 13th and the 21st of January 2011 to observe how the youth interacted with their instructors, how they learned, and the types of activities they enjoyed. We observed and directly participated with the youth in two Eco-Warrior environmental education sessions. During these sessions, we observed and noted their reactions, behaviours, and knowledge towards the content being taught and their participation in the program activities. We also attended and participated in a basketball program to observe how they acted outside a classroom-learning environment. We recorded the information we gathered from these observations and compiled them in an observational journal. We actively participated with the youth in their activities to observe their interest levels and motivation to learn about the presented subject.

Once the Banksia Gardens Community Centre programs reopened after the summer holidays on the 1st of February 2011, we observed and interacted with the people who visited and attended Centre programs. One program we observed and directly participated in was the pilot class of the Introduction to Sustainability course taught by Peter Lazarus. Lazarus is a retired electronics engineer who is thoroughly interested in environmental sustainability. We also sat in the lobby and interacted with the visitors who come to the centre to get to know them. The interactions took place in casual settings in order to avoid intimidating the subjects

so they were open with us. Our observations are documented in the observational journals in Appendix F.

3.1.2 Interviews with Banksia Gardens Community Centre Staff

In addition to direct interactions with our target audience, we also interviewed our project liaisons, Jaime de Loma-Osorio Ricon, the Community Development Coordinator and Eco-Warriors coordinator at Banksia Gardens Community Centre, and Gina Dougall, the centre manager, and Banksia staff member, Nick MacHale, the Community Connections Manager, to gain a better understanding of the community. Since the directors manage all the programs at Banksia Gardens Community Centre, they have personal experiences and observations of the community members who are involved with the centre. MacHale works with members of the Banksia Housing Estates that lodge under privileged families. The first few questions were aimed to gain an understanding of the demographics and diversity of the Broadmeadows community. This information was important because it helped us understand the community's background. We also asked the staff members about the types of people who use the community centre and the popular programs they noticed the community enjoyed attending. We felt this information would help us model our activities after the successful aspects of the popular programs as well as help us develop the criteria on which to select our displays. The last question we asked was their opinion about which sustainable topics they thought the community would enjoy learning. From this information, we were able to start selecting the appropriate information to be presented on the displays.

3.2 Building the Framework: Features of a Sustainable Building

Our project focused on educating the community about environmental sustainability through presenting the sustainable features of the community centre. In order to achieve this goal, we learned about sustainable construction and simple, sustainable practises. We completed background research by looking into topics such as energy, water, construction materials, recycling, composting and community gardens. Once we were on site, we toured several sustainable buildings and conventional homes to learn how a building can be

constructed using Green Star accredited, sustainable but not accredited, and non-sustainable methods and materials. We also thought this would assist us in our research of how a non-sustainable building can be used sustainably. Along with attending tours of sustainable buildings, we also conducted interviews to learn more about the specific sustainable features that applied to the current constructions at Banksia.

3.2.1 Sustainability Tours

We toured Sustainability Victoria, Goods Shed North and the City of Melbourne Council House 2. We decided to tour Sustainability Victoria and the Council House 2 because their design and construction was based on sustainability principles. The purpose of these tours was to allow us to visualise the key points of Green Star accredited sustainable constructions and to identify the best materials to use when constructing a new building. We used the information gathered from these tours to compare the buildings' features to the features in the community centre's new classroom. To help us understand our research better, we also toured the Goods Shed. We toured the Goods Shed to learn more about sustainable renovations to an existing structure similar to the renovations to Banksia Gardens Community Centre. These three tours allowed us to gather information about large, sustainable office buildings.

We thought it would also be beneficial to learn more about the construction methods used to build conventional houses in the Broadmeadows area. Lazarus took us through a tour of the houses in his surrounding neighbourhood to see conventional houses under construction, houses with sustainable features and the sustainable features he has added to his own house. We believed that these tours introduced us to building materials and practises that are used in Australian construction as opposed to those used in the United States. This information was essential for familiarising ourselves with the average house in the area. By seeing the sustainable features Lazarus added to his house, we felt that we would learn some simple features and practises that could be later taught in our displays.

3.2.2 Interviews for Construction Information

To create displays for the community centre we needed to gain knowledge of the renovations made to the existing community centre and the new classroom. Consequently, we conducted interviews with Jaime de Loma-Osorio Ricon and Hao Lee. Lee was the architect who designed the new sustainable classroom. We interviewed de Loma to gain a general understanding of the new construction and to identify the features we needed to discuss with the architect. We asked de Loma the purpose for the renovations to the existing community centre and creation of a sustainable classroom, about the renovations to the centre, and the materials used for the renovations and the classroom. We also identified which materials were not used so we could make comparisons between the sustainable and non-sustainable materials. We obtained plans for the new classroom so we could generate questions to ask the architect.

We interviewed the architect, Hao Lee, to identify the specific sustainable materials that were being installed in the new classroom, as well as their locations in the classroom and around the centre. We chose to ask him a few introductory questions to understand his background and prior experiences with sustainable construction. The questions that followed asked him to identify all the construction materials and to elaborate on their purpose and the sustainable concepts that drove the use of the particular products. This specific information helped us select the information to present in our displays and where each display would be located throughout the centre. We obtained the final set of blueprints from the architect as well as the final list of materials used. The blueprints and materials list helped us identify features that were overlooked during the interview.

The interviews with de Loma and Lee were important, as well as the tours of the Sustainability Victoria, Goods Shed North, Council House 2, Broadmeadows houses, and Peter Lazarus' house. These interviews and tours allowed us to identify the key features in sustainable construction, as well as the features put into the renovated building and new classroom.

3.3 Raising the Walls: Selecting Suitable Displays

Before determining which displays to place throughout the new and existing centre, we first brainstormed ideas for displays. These ideas were derived from a variety of sources that included a visit to Scienceworks Museum in Melbourne and interviews with several environmental educators. However, time and budget constraints made it impossible to design, create, and implement all the displays we originally brainstormed. Consequently, to eliminate ideas we developed criteria that were used to create a decision matrix. This decision matrix helped us determine the best and most practical displays and activities to implement within the community centre.

3.3.1 Gathering Information for Brainstorming

Museums around the world engage and excite people about countless subjects daily. Since engaging and exciting people about environmental sustainability were the central focus of our project, we felt Scienceworks Museum would be a great place to visit. Scienceworks provides fun and interactive learning. They teach science and technology in an interactive setting by using hands-on activities and live demonstrations (Museums Victoria, 2011). We contacted the museum and arranged a meeting with Pennie Stoyles, the Public Programs Manager, and Andrew Lewis, the Exhibition Manager. From our meeting with them, we were educated further about interactive and engaging displays that successfully interested people. The information obtained in this meeting assisted us in formulating more ideas that would excite the Broadmeadows community about sustainability.

We also conducted interviews with environmental educators within the Broadmeadows community to gather more information necessary to design and select suitable displays. These individuals included Peter Lazarus, Georgina Murphy, an Environment Education Officer at the Hume City Council, and Megan Bond, an Eco-Warrior working with Banksia Gardens Community Centre in their holiday programs. In each interview we obtained more knowledge about effective ways to educate the Broadmeadows community.

Lazarus, due to the nature of his course, works closely with people contained in our interested but uninformed or interested and informed target groups, making him a valuable resource to interview. We devised our questions to focus specifically on topics that included his sustainability course topics, his interest in sustainability, his students, teaching strategies to inspire behaviour change, why he believes sustainability is important, and anything specific that should be included in our displays. We felt his answers to these questions provided us with more ideas regarding displays and activities that could interest the Broadmeadows community.

A meeting was arranged with Georgina Murphy, the head of the environmental team at the Hume City Council, who works closely with her staff, the Green Team, to inspire and excite people about sustainability in the greater Hume area, which includes Broadmeadows. Her job is strikingly similar to our project goal; therefore meeting with her provided us with a plethora of ideas that worked or did not work to motivate people. During our meeting she gave us a presentation regarding programs and activities she and her team employed for the Hume City Council staff. The presentation provided us with information above and beyond what we were seeking from our interview.

Megan Bond is an Eco-Warrior working in collaboration with the community centre. The Eco-Warriors have several goals that have proven to be valuable guidelines for our project. Some of these goals include linking sustainable issues with the social reality of the community, providing practical solutions that reduce environmental footprints, and focusing their teachings on schools and young people. Furthermore, because Bond works primarily with the disinterested and uninformed group, youth, we felt she was another valuable resource. In our interview with Megan we asked questions regarding her role as an Eco-Warrior, her interest in sustainability, the importance of sustainability, programs that interested the youth she worked with, and important sustainable practises we should convey in our displays and activities. From the questions we gathered further information about the Eco-Warriors as well as more ideas to interest the community and youth about sustainability.

3.3.2 Brainstorming

After examining our notes from the interviews, we brainstormed ideas for displays and activities. We focused our attention initially on displays and activities our liaisons stressed to us they would like to see as part of the final product. Next, we brainstormed ideas from the information we received from our interviewees. Finally, we developed our own ideas that we felt were interactive. As we devised ideas for possible displays, we also included a description of the type of information to include and the message we wanted to convey through the displays. We also brainstormed tentative locations to place these displays as well as the materials we needed to construct them. However, due to time and budget constraints it was not possible to produce all of our ideas.

3.3.3 Choosing Criteria

In order to select the best-suited interactive displays and activities to design for Banksia Gardens Community Centre we created criteria to select these tools. These criteria were developed based on the information we gathered from the interviews with the centre directors and staff and our project constraints and expectations. Before we ranked these criteria, we consulted our liaisons to obtain their input.

These criteria were then analysed using a pairwise comparison chart as described in Gerard Voland's academic textbook, Engineering By Design. The table in Appendix F shows the pairwise comparison chart we obtained using Voland's method. This chart provided us with an opportunity to narrow our focus and obtain a better estimate of the relative significance of each criterion than if we had considered all the criteria at once (Voland, 2004). The scores for each criterion were added together to determine a rank order of design criteria for our displays. Next, we assigned weighing factors to each criterion. This weight factor was based on the rank order developed from the pairwise comparison chart. To accomplish this task we first decided on the range of values that were used for the weight factors.

After assigning the weight factors to each of our criteria we developed a scoring rubric or rating factor. Since we could not convert each criterion into a truly quantitative form we

developed a rubric, which was necessary to determine how well each tool achieved each criterion. The rubric explains in detail what each score would mean to avoid ambiguity and bias in the scoring process. The weight factors for the display criteria, together with the rating factors for each display, were then inserted into a decision matrix. Each weight factor was multiplied by the corresponding rating factor for each display, producing a decision factor. These decision factors were then summed and stored in the right most column of the matrix. The displays were then compared on a criterion-by-criterion basis. We focused our analysis on the individual ratings achieved by displays on the most important criteria. If one design was clearly superior to others in its ability to achieve a critical criterion, but not as effective as the others in achieving less important goals and thereby resulting in an overall tie score, then it was chosen as the better solution (Voland, 2004). This method provided us with the most suitable ideas for displays to install in the Banksia Gardens Community Centre.

3.4 Closing in the Building: Developing Displays and Activities

Our next objective was to create the educational and interactive displays and activities about the building and about sustainability to be positioned throughout the centre. These displays and activities were used as tools to engage the members and visitors about sustainability in construction and simple practises. To accomplish this we developed a layout for each of our displays and then follow through with creating the products.

3.4.1 Creating the Layout and Design of Displays and Activities

Once we selected the displays and activities to produce, we arranged meetings with Samantha Donaldson, Banksia Gardens Community Centre's administration manager and graphic designer, to assist and guide us in developing our displays. She designs posters and pamphlets for the community centre and we worked with her to develop the graphics, layout and presentation of our information based displays. She provided us with the necessary computer software and taught us how to use it.

We used ideas gathered from our visit to Scienceworks and concepts we gathered from environmental educators to design our engaging activities. Our liaison, de Loma, also arranged

a meeting with a team of environmental volunteers for us. We conducted a brief presentation to familiarise them with our project and the displays we have selected to produce. After the presentation, we discussed and delegated the volunteers with assignments they can oversee.

3.5 Finishing Touches: Assessing the Educational Tools

Before we printed the final tools, including posters, activity sheets and tour displays, we determined the success of a sample of our interactive displays and activities by organising a showcase of prototypes of our products to be critiqued by community members. We found volunteers ourselves by interacting with the members of the centre. This sample of the community included both youth, who we inferred were our uninformed and unmotivated group, and adults, who we inferred were the more motivated yet uninformed group. We also showed our trial displays to members of the community that were more informed and motivated. We administered pre-surveys before the participants saw our displays and activities to determine their knowledge and interest regarding environmental sustainability. A sample of the surveys can be found in Appendix R. For the participants who were unable to write their responses on the surveys, we verbally asked them the questions on the surveys and recorded their responses, in the style of a focus group. We then led the sample groups through a mock building tour. After the program, we administered a follow-up survey to assess what they learned from our displays. The survey also asked the participants what they enjoyed from the program, what they did not enjoy, and suggestions for improvement. Again, the survey was administered verbally to the participants who were unable to record their answers, in a focus group style. The information gathered from these surveys and observations helped us assess the success of our products as well as provided us with suggestions for improving the displays and activities we developed. It also enabled us to make recommendations for our sponsor to further increase the community's awareness in environmental sustainability.

3.6 Summary

Our goal was to raise awareness about the importance of environmental sustainability and establish affordable, sustainable practises the community can apply in their everyday lives. To achieve our goal, we completed five objectives. These objectives were:

- to assess the community's interest and knowledge level in environmental sustainability,
- to identify the sustainable features at the community centre as well as sustainable features in other sustainable buildings,
- to design and select the best-suited displays and activities,
- to create interactive displays and engaging educational activities about sustainability in the community centre, and
- to assess the success of our displays and activities in educating and motivating the community.

To fulfil these objectives we first conducted significant research to better understand the scope of our project. We focused our research on general sustainable construction and practises as well as effective teaching and motivation techniques suitable for our target audience. To fulfil our first objective we acquainted ourselves with the community by observing and conversing with the youth and visitors to the centre. This helped us determine motivational tactics and the amount of knowledge they had about environmental sustainability. We also conducted interviews with the centre staff to learn about the community. We conducted interviews with the architect and our liaison, and completed tours of sustainable buildings around Melbourne to learn more about sustainable construction. We also visited houses in the Broadmeadows community to see the difference between homes with sustainable features and homes without. To investigate the design of engaging displays, we visited Scienceworks, conducted interviews with environmental educators, and chose criteria for a decision matrix. To create our displays we met with the Centre's graphic designer, selected the best information to display and researched the best materials, within budget, for the displays and activities. With all of the information gathered we have created interactive tools and displays to raise interest

and knowledge concerning ways the community can achieve or improve environmental sustainability.

4.0 Results and Analysis

The underlying purpose for the sustainable constructions to the Centre, as de Loma explained in our interview, is to act as a facilitator to inform the community of the sustainable actions Banksia Gardens Community Centre is taking to ensure a more sustainable future. It is our goal to use this construction project to develop tools that educate and motivate the Broadmeadows community about environmental sustainability. In this chapter, we discuss the findings we obtained through our methodological approaches. First, we review our objectives and explain how the information we collected was crucial for completing these objectives. Then, we describe, in detail, the ideas we brainstormed and connect the inspiration for each idea to the information we gathered. Next, we give in depth analysis regarding our final grading criteria and selection of instructional materials. Finally, we address the feedback and suggestions we obtained while assessing and analysing the success of these tools. The information gathered from our methodological approaches that are presented in this chapter contributed to the overall success of our project.

4.1 Laying a Foundation: Determining Interests and Knowledge

Through the youth and community participatory observations and interviews with the Banksia staff we gathered the necessary information to develop the groundwork for our project. The observations and staff interviews helped us determine the interest and knowledge levels of the centre visitors. We discovered that the visitors to the community centre are a diverse group of people. To develop displays and activities that encompass the entire community, we decided to divide the community into three groups based on their level of interest and knowledge concerning matters with environmental sustainability. One group is people who are interested and informed in environmental sustainability; another is people who are interested but uninformed about sustainability, and lastly, people who are disinterested and uninformed about sustainability. Dividing the community into these three groups allowed us to be considerate of

everyone in the community when determining the designs and information incorporated into the interactive displays.

4.1.1 Uninformed Audience

We noticed that the majority of the community are disinterested and uninformed about environmental sustainability. However, there are a few youth and community members who are interested in environmental sustainability to varying degrees. Our observations of the youth at the Banksia Gardens Community Centre Holiday Programs during the first Eco-Warrior session revealed that many of them did not enjoy learning about topics of environmental sustainability in a lecture setting. Many of the students were disinterested and not engaged during this first session. However, with some encouragement, some of the youth made an effort to participate in the activity. The second Eco-Warrior session was more interactive and incorporated a hands-on activity. In this session the students displayed positive feedback and enjoyed the engaging activity.

From the interviews we conducted with the Banksia staff members, de Loma, Dougall and MacHale, we concluded that the majority of the Broadmeadows community does not prioritise environmental sustainability due to many of their other concerns. Many of them have only completed their twelfth year, are unemployed, and/or are from a foreign country. MacHale stated that the low-income community who live in the Broadmeadows Housing Estates do not pay for the water they consume; therefore they are not motivated to conserve water. We concluded that most of the community is unaware of the effects of poor environmental practises and is unmotivated to perform environmentally sustainable practises**,** due to the lack of knowledge and excitement of these topics and/or an issue of financial status. However, we have seen that people can be motivated by their budget to participate in environmental practises. Through our interview with de Loma, we discovered that a Turkish woman who lives in the area uses barrels connected to the drainage pipes to create a rainwater collection system in her backyard and with this water she waters her garden and washes her clothes.

4.1.2 Interested and Informed Audience

We also discovered the people who are actually interested and knowledgeable about environmental sustainability are people who are more informed than the general community. These included our primary liaison, de Loma, the three individuals who were enrolled in the Introduction to Environmental Sustainability course offered at Banksia, and their instructor, Lazarus. All these individuals expressed a personal interest in environmental sustainability. We concluded from our observations of the class that people who are already interested in environmental sustainability did not require an interactive activity or flashy display to entice them to learn about sustainability. We also noted that the class was mainly discussion based with PowerPoint presentations and the students paid attention because they wanted to be there. Upon asking the members of the class what they would fancy seeing in our displays, they expressed their interest in learning more about the functions of each sustainable feature and their rebates and a cost analysis of the money that is saved by using them. They seemed very motivated by the amount of money sustainable features and materials can save if installed in a building. Also, we considered the group of environmental volunteers we met with about assisting us with the production of our displays are interested and knowledgeable about environmental sustainability as well.

Our findings in our background research combined with the information we collected from community observations and interviews led us to the conclusion that in order to effectively educate and motivate individuals, especially the youth, to actively perform environmentally sustainable practises, the educational material must be interactive and engaging to capture the audience's attention. Also, according to the information in Section 2.5.2, adults are motivated by money because it is a vital asset in today's society. Therefore displays that provide information about ways the community can simply and affordably reduce their consumption rates and the cost analysis of all the sustainable features around the community centre were also important for the brainstorming process.

4.1.3 Engaging Our Audience

A recurring concept from our background research in Section 2.4 and interviews with environmental educators was that it was important to engage and motivate the audience. People cannot be forced to change their behaviours; they must be empowered to want to change. We understood through our interview with Murphy that a promising way to generate a mind shift towards environmental sustainability is to address environmental problems in a way that is personally relatable to members of the community. This idea is supported by the background information on community-based empowerment presented in Section 2.4.1. We also noticed through our observations of the children at Scienceworks Museum that environmental education can be very beneficial if concepts are taught to people at an early age. However, to effectively instil a sustainable mindset in youth, the teaching methods must be engaging and hands-on because youth learn the best that way, as discussed in Section 2.5.1. At the recycling demonstrations at Scienceworks, the children were engaged with cranking the lever and saw the types of recyclable materials that were separated from rubbish. Thus, they were physically playing and subconsciously learning.

4.2 Building the Framework: Features of a Sustainable Building

Our second objective was to build the framework of our project, by identifying the sustainable features at the community centre and in the new classroom as well as key features in other sustainable buildings. In order to complete this objective we went on several tours of Green Star accredited sustainable buildings as well as a tour of a housing development in the Broadmeadows area. We also interviewed de Loma and Lee to identify the sustainable features in the centre and new classroom.

We noticed that natural lighting, passive design, solar panels, window shades, insulation, double glazed windows, rainwater collection tanks, dual flush toilets, and different sustainable materials are common features that are used in constructing the classroom and other sustainable, Green Star accredited buildings. Our tours of the Goods Shed North, Sustainability Victoria and the Melbourne City Council House2 (CH2) helped us compare the sustainable

aspects of building construction between Green Star accredited buildings and unaccredited buildings with sustainable features. We determined that the difference between the accredited and non-accredited buildings is in the advancement of the sustainable aspects in the office buildings but the principles behind the aspects are the same.

4.2.1 Energy Conservation in Buildings

We found that energy conservation is an important aspect of sustainable buildings. Whether the building is an office building or a home, if it is sustainable, it has aspects of energy conservation. Some sustainable construction strategies and features that work towards energy conservation are using natural lighting, a passive building design, solar panels, energy-efficient light bulbs, window shades, insulation and double glazed windows.

Natural lighting can reduce the amount of energy consumption in a building because there is no need to turn on lights during daylight hours. Each of the buildings we visited had windows strategically placed around the building in order to maximise the amount of natural light that enters the building during the day. At Sustainability Victoria we learned that the windows closer to the roof were smaller than the ones near the ground of the building. This was because as the height of the building increases, more sunlight enters the building because there are fewer surrounding buildings that block the sun's rays. Also the lights within the office have light sensors; therefore they get dimmer as they are located closer to the window because there is no need for extra light. The principles behind this design are similar to the design of the new centre classroom. The windows on the north side are bigger than the ones at the south side in order to increase the amount of natural lighting to the building. This principle of orienting the building in a way that maximises the sunlight is known as passive design and can be used in the design of any building or house.

Passive design not only encompasses the size of the windows or orientation of the building but it also incorporates other aspects of the design as well. The principle of passive design was used in the CH2, the Goods Shed and in the design of the new classroom. CH2 has curved ceilings in order to create better air circulation while the ceiling of the sustainable

classroom is slanted to help with ventilation. In addition, all three of the buildings we visited have an open office policy. They did not have closed rooms as offices; instead desks and workspaces are set up throughout a large space. This tactic helps with air circulation as well. Each of these buildings used different passive design techniques but each building effectively tailors these techniques to accommodate its surroundings.

Solar panels are a sustainable solution to energy consumption. CH2 has solar panels and Banksia is installing them in the courtyard of the current community centre. When touring the Broadmeadows area, Lazarus pointed out many houses with photovoltaic or photovoltaic thermal panels. We concluded that solar panels are not only being used in Green Star accredited buildings but also other commercial buildings and houses that do not have accreditation.

Window shades or shutters help to keep the sunlight or heat from the sun from entering the building. They are easy features to add to a building and we noticed them at the CH2 and Lazarus' house. The shades of the CH2 resemble shutters that automatically change their angle depending on the position of the sun. Similar to CH2, the shades at Lazarus' house are on the outside of his house. However, to adjust the shades, he has to go outside and manually lower or raise the shades. Banksia is also using window blinds in the sustainable classroom to prevent the heat from the sun from entering the room, but simultaneously allowing sunlight in. Instead of having their shades outside of the building, the shades are located inside and have a metallic outer layer to reflect the heat from the sun and keep it out of the building. Although each of these shades is different, their basic principles and uses are for the same purpose.

Insulation is a feature we did not find in use during our tour of Broadmeadows houses. From our interview with de Loma, we learned that this was the normal practise in Australia. However, BGCC installed insulation in the function hall in the centre and the classroom because of its sustainable properties. Insulation is used to keep heat in a building during the cold months as well as to keep in cool air during hot months. From our background research we found that insulation can help reduce energy consumption and save money.

Double glazed windows are a standard feature in buildings in the United States; however they are not in Australia. Through our tours at the accredited sustainable buildings, we discovered that all of them used double glazed windows. However, we found that installing double-glazed windows in homes or other conventional buildings is not a standard practise. By interviewing de Loma and Lee, we determined the windows of the new classroom are double-glazed. Lazarus used e-film to make his single glazed windows operate similar to double-glazed ones. E-film is an alternative solution to double glazed windows with similar principles to the idea of double glazed windows.

4.2.2 Water Conservation in Buildings

We observed that the concepts of water conservation are apparent in every building that strives for sustainability. Whether it is with high-tech rainwater collection tanks that recycle water for toilets and reuse in the building or simple systems that collect rainwater to water plants, the idea of water conservation is universal.

Water tanks are one of the sustainable features that have been added to the Banksia Gardens Community Centre and are apparent in CH2 and Lazarus' house. From our tour of CH2 we learned that the rainwater collected was used for the toilets. However, connecting the plumbing of an existing building to a water tank is expensive. Therefore, at the community centre and Lazarus' house, the water collected by the rainwater collection tank is not used for toilets but for watering the gardens.

One of the most common sustainable feature we have seen on all our tours are dual flush toilets. These toilets are incorporated in each of the sustainable buildings we toured as well as the community centre and our apartments. According to de Loma, the centre added them along with the other renovations to the centre in order to reduce water consumption.

4.2.3 Sustainable Construction Materials

Various sustainable materials were used in the construction of each building we visited; they are also being incorporated into the new classroom. The materials may not be the same; however, the principle is that these materials help to reduce the use of natural resources.

Bamboo flooring is incorporated into the classroom due to its sustainable features described in Section 2.2.3. CH2 and Banksia have timber window frames as opposed to metal or another material. Timber is not necessarily sustainable but it does not consume as much energy to produce the timber for the frames as it would to produce a metal window frame resulting in energy conservation.

4.3 Raising the Walls: Selecting Suitable Displays

In order to educate our three different target groups about the sustainable features of the community centre and empower them to participate in sustainable practises, we decided to create a variety of displays and activities. We conducted interviews with centre staff and environmental sustainability educators, attended sustainable building tours and observed the community through participant and direct observation. Using the information from these qualitative methods, we brainstormed numerous ideas that were tailored to the Broadmeadows community.

4.3.1 Brainstorming

During our brainstorming sessions, we developed ideas for each of our target groups. Our development of ideas focused more on ideas for educating and motivating the disinterested and/or uniformed, as those groups composed the majority of the Broadmeadows community. However, we have devised ideas that targeted people who were interested and knowledgeable about environmental sustainability. A complete list and brief description of the brainstormed displays can be found in Appendix J.

From our background research in Section 2.5.3, visual displays are effective in teaching people who are visual learners. Therefore, we brainstormed displays that are visually interactive such as a fluorescent-incandescent light bulb comparison display that demonstrates the difference in the amount of energy required to power each type of light bulb. These types of displays can target visual learners from all three of our target groups. We also brainstormed text-based visuals including informational posters and a building tour that are information

dense. These types of displays target individuals who are interested in environmental sustainability.

Our research in Section 2.5.3 and our visit to Scienceworks supported the ideas that involve physical activity, social interaction and/or tactile components to teach and motivate those who are either interested or disinterested. We generated ideas such as a "What am I?" scavenger hunt that involves participants, namely the youth, to go around to the building tour displays to find the answers for an attractive questionnaire. Requiring the participants to actually find the answers helps them to learn subconsciously and generates a sense of motivation to discover the answers to the questions. Another interactive display we brainstormed was a bicycle display. This display requires the participant to physically pedal a bicycle, which illuminates a string of lights that are attached to the bicycle. Through this demonstration, participants can feel the amount of energy they must exert to light a string of light bulbs and this can help them relate to the amount of energy consumed each day with just the simple flick of a light switch.

To educate the disinterested and make them interested, the community members must make the decision to be sustainable on their own. We discovered through our interviews with environmental education experts that one of the most effective ways to inspire people to be sustainable is to make it look fun and exciting. We developed ideas such as creating an eye-catching recycling centre and a sustainability promotional video advertisement. Rather than just showing the type of rubbish that goes in each bin on a piece of paper, the pictures and descriptions are painted onto the recycling system to make it more attention grabbing and more of an enjoyment. We came up with these displays and activities to excite the community and show them that practicing sustainability can be fun.

From our interviews with environmental educators, we discovered that it is beneficial to develop displays and activities that recognised local leaders in the community. We developed ideas such as promotional posters to be posted on the windows around the office of the community centre. These posters picture community members who take action to be

environmentally sustainable. They include individuals who collect rainwater, water the community gardens, bicycle to work rather than driving, recycle and turn off lights to save energy. Recognising people for their good deeds motivate them to uphold their practises and other members who know them are more inclined to adopt sustainable practises as well.

Overall we brainstormed a total of 24 display and activities. Nevertheless, it was not possible to create all 24 ideas. As a result, we developed criteria to grade each display and activity and rank them against each other to determine the best display for the community.

4.3.2 Choosing and Ranking the Criteria

To effectively and analytically determine which displays and activities were the best, we had to develop grading criteria. From conversations with our project liaisons we developed a list of nine criteria we believed were essential to incorporate in our displays. These criteria included risk, time, cost, aesthetics, maintenance, ease of use, versatility, personal relevance, and interactivity. We presented the list to our sponsors to determine their thoughts about which criteria they felt were most important. They made it clear to us that risk was undoubtedly the most important criterion on the list because Banksia is a community centre and there are always children around. They stressed that the designs and displays we developed must be safe to use. Next, they noted that aesthetics were extremely important but the displays and activities must be low maintenance. They wanted the displays and activities to look professional and intriguing, but require little to no maintenance. Our liaisons also emphasised that the displays must be easily understood and straightforward. Many of the people who use the community centre speak English as a second language and are uninformed on topics regarding sustainability. Therefore, the information must be presented in its simplest form to have the largest impact. Finally, they felt less strongly, but wanted to still emphasise the importance of versatility and interactivity. They did not feel all the displays and activities needed to appeal to all three-target groups or be interactive, but felt some of them should. Making the tools versatile and interactive would engage the community members and promote a community-based learning environment. At the conclusion of our conversation, they indicated

that cost and time to make the tools was not of the utmost concern to them. We were given a budget for the collective cost of the displays, and the team determined the distribution of the money spent on each display.

We considered all of this information in order to grade the criteria alongside one another in a pairwise comparison chart. The completed chart is available in Appendix I. The final rankings of our criteria in descending order of importance were as follows: risk, maintenance, aesthetics, ease of use, versatility, time, personal relevance, interactivity, and cost. We felt, just like our sponsors, that risk was the most important criterion. Safety for community members is the ultimate concern and essential for success. Maintenance ranked second because the community centre is a highly trafficked area. It is used by a wide variety of people and groups on a regular basis. Therefore, we felt it was important that we develop tools that were not only durable and could withstand heavy usage, but also required little or no effort from the centre staff to operate or maintain. Thirdly, we felt aesthetics were also very important; everything needed to look professionally done and intriguing. Getting the community involved in sustainability was the ultimate goal of this project, and having eye-catching, attention-grabbing tools was, we felt, the first step towards achieving this goal.

The next highest ranked criterion was ease of use. Since many of the people who use the community centre are uninformed and/or disinterested in topics regarding sustainability we felt it was crucial for the success of our tools to be easy to understand and use. If they contained difficult information to comprehend or were difficult to operate, our message would not be understood. Versatility and time were ranked fifth and sixth on our list. We felt versatility was next most important because we wanted to promote a community based learning environment and having tools that appealed to more than one interest, age, or cultural group, we believed would accomplish this goal. Time was considered our next greatest concern because, we felt as a group, a personal determination to install as many tools in the community centre as possible while we were on site. We did not want to leave Banksia Gardens Community Centre with suggestions for the staff, which were our ideas we could not finish.

The next three criteria, relatable, interactivity, and cost were not as critical to success as the previous six. We wanted the information we presented to be relatable for the community members but felt that the other factors explained above regarding the presentation were more important. Additionally, we initially felt that interactive tools should be one of our primary concerns. However, after talking to our sponsors and discussing the criterion as a group, we felt we could still interest our target audience in other ways and therefore decided that interactivity was less important. Finally, we felt that cost was the least important criterion. Originally, we felt cost was going to be the most important criterion. Without sufficient funds, it would have been difficult to develop professional displays that attracted the community's attention. However, the budget provided to us by Banksia was substantially larger than we anticipated. Consequently, because we already had all our tools brainstormed and a general idea of how much they would cost, we determined cost was no longer a vital criterion. This information was then used to create a decision matrix.

4.3.3 Selecting the Displays to Create

We used a decision matrix to determine which of our 24 tools were the most suitable for the community and reasonable to complete in the restricted timeframe. This method helped us eliminate many of the tools and focus our efforts on those that would most effectively engage the community. Before we ranked each tool using the decision matrix, we first established a weight factor and rubric for each criterion. Our rating scale and final weight factors are available in Appendix I. We also developed a scoring rubric to assist us in determining how well each tool achieves each criterion. The rubric is available in Appendix I. We then generated the decision matrix, which can be found in Appendix K.

Before discarding the lower ranked ideas, we analysed the data to ensure the tools that achieved the more important criteria were included over those scoring higher in the less important criteria. This process determined the tools we created for Banksia Gardens Community Centre. The top-ranked displays and activities are as follows: promotional posters, a recycling centre, a recycled art sculpture, self-guided tours, the bicycle display, plants around

the building, sustainability promotional video, a scavenger hunt, informational posters and rolling facts.

4.4 Closing in the Building: Developing Displays and Activities

After selecting the displays to create, we used the display briefs we created in Section 4.3.1 to figure out the logistics and details for the chosen displays. We created the recycling centre and purchased plants from Bunnings Warehouse™ to place around the centre. Using Adobe Illustrator, we developed layouts and templates for the promotional poster, informational posters, self-guided tour displays, and the quiz sheets for the scavenger hunt. The promotional and informational posters and quiz sheets were sent to Impact Digital, a paper printing company; whereas the self-guided tour displays were sent to Quick Smart: Commercial Signage to be printed on transparent acrylic plaques.

4.4.1 Recycling Centre

The recycling centre was a product our sponsors stressed they wanted to see implemented into the building. This was convenient because after completing our decision matrix we found that it was the third highest ranked display. Our sponsors explained to us they tried several times to create a recycling system but have been unsuccessful in developing one that was effective. Therefore, they asked us to create a long-lasting recycling system that could be used in the centre. The idea we brainstormed was a large wooden box that had three equally sized slots for rubbish bins, one for each of the centre's different types of rubbish and recycling. The box was built from raw materials using structural timber, plywood, and medium-density fibreboard (MDF), purchased from Bunnings Warehouse™. The structural timber was used to construct the frame, while the plywood and MDF were used for flooring, doors, and to enclose the structure. Figure 9 below shows the final design of the centre.

Figure 9: Recycling Centre

This design allows people to throw rubbish into the bins using the top door, but also allows for the bins to be removed from the box out the front door when they need to be emptied. Finally, we had to develop an idea to make people want to use the centre. We decided we wanted to have an artist paint the box with the different types of materials that belong in each bin. We felt that making the recycling centre into a piece of artwork by painting it would excite the visitors about using the recycling system because it would catch their eye, intrigue them, and encouraging them to use the box correctly. Additionally, it turns rubbish, something normally looked at negatively, into a form of art. More pictures of our recycling centre are available in Appendix P. The recycling centre is centrally located within the building, underneath our informational posters, so it is visible and accessible.

4.4.2 Plants Around the Building

From our background research we learned that leafy green plants act as natural filters and improve indoor air quality. Upon completing our decision matrix, we found that our idea for placing plants around the building ranked as the fourth highest. We conducted additional research into plants that are low-maintenance, efficient in improving indoor air quality, and affordable. We concluded that types of palms, ferns and ivies were the best options. After the research was complete we consulted employees at Bunnings Warehouse™ to refer us to their stock of palms, ferns and ivies. We purchased six plants; two Flaming Flowers, one Yucca

Elephantipes, one Cocos Palm, one Parlour Palm and a Variegated Shell Ginger. Pictures and descriptions of these plants are available in Appendix O. We also purchased pots, trays, potting soil, and green spray paint. Upon returning to Banksia Gardens we spray-painted four of the pots green to tie into Banksia's sustainability theme, potted the plants, and placed them around the building. Below in Figure 10 are two of the plants we purchased.

Figure 10: Variegated Shell Ginger (left) and Yucca Elephantipes (right)

4.4.3 Promotional Posters

Inspired by promotional posters Murphy, the Environmental Education Officer from the Hume City Council, had created for the Live Green Work Green campaign, we designed promotional posters that demonstrated individual community members performing a simple sustainable practise. These posters were mounted on the windows that surrounded the main office at Banksia Gardens Community Centre. We wanted to have pictures of people who took action on collecting rainwater, watering the community garden, cycling to work rather than driving, recycling, turning off lights and using window blinds to save energy. We were able to obtain a picture of MacHale who often rides his bicycle to work, and a picture of Lazarus pulling down a window blind on his house. For the other four pictures, de Loma selected leaders of the community who already follow the practises we were looking for. He arranged a meeting with Fatma Doganay, to take a picture of her with the rainwater collection system she built in her

backyard. He also asked a volunteer, Heidi Technau, who waters the gardens regularly to pose for a picture. De Loma also selected two students, Mustafa Housain and Douha Elbaba, to pose while recycling and turning off lights. These pictures were then superposed on a coloured background, and a sentence was added to the picture that explains what action the individual is taking. These promotional posters are meant to be an inspiration for the community to take action. To see the promotional posters we created, refer to Appendix L.

4.4.4 Informational Posters

The set of informational posters includes an A2 sized centre poster and six A3 posters. The large centre poster briefly describes the history of the centre and the purpose of the Eco-Warrior projects and their primary funding agency. The six other posters contain information about climate change & biodiversity, energy efficiency, water conservation, recycling, composting, and pollution. These posters were framed and mounted on the wall in the main lobby, directly opposite the main entrance. The layout of the informational posters was inspired by examples we have seen from our personal observations. We used pictures related to the theme of the poster as the backdrop. Informational text is located on the left hand side of the posters describing the effects of poor environmental practises, the importance of reducing these negative effects, and/or actions Banksia Gardens Community Centre is taking to achieve sustainability. The text is superposed on an opaque coloured background that matches the colour scheme of the background picture. To the right of the information and on top of the picture are three translucent words in different shades of grey that are specifically related to each poster. Figure 11 below shows the set up of our informational posters and recycling centre. For examples of the six informational posters, refer to Appendix M.

Figure 11: Informational posters (above) and recycling centre (below) displayed in lobby

4.4.5 Self-Guided Tour

Samantha Donaldson generated the template for the self-guided tour displays. We developed ten descriptions to showcase ten sustainable features that were added to the community centre during the construction period. The description briefly explains the feature and its function. A witty "Did You Know?" fact about the sustainable feature or concept is included in the bottom right corner to surprise the reader and teach them interesting information. The tour displays were mounted throughout the centre and the new classroom next to the sustainable structure that it describes. Refer to Appendix Q for the samples of these displays.

4.4.6 "What am I?" Scavenger Hunt Quiz

Using the sample of the Humanoid Quiz sheet, Figure 43 and 44 in Appendix H, we obtained from an exhibit focused on human body functions during our visit to Scienceworks Museum, we created two versions of our own quiz sheet called the "What Am I?" quiz. Each version had five simple multiple-choice questions and three factual questions that led the participants to different sustainable features in the centre and classroom. The answers to all

the questions could be found in the information provided on the self-guided tour displays. Refer to Appendix N for the sample of these quizzes.

4.5 Finishing Touches: Assessing the Educational Tools

Before sending our displays in for final printing, we conducted an assessment to determine if the displays we created were informative and motivational as intended. In a three day period, we gathered 19 participants, who entailed five youth aged 14-19, seven young adults aged 20-30, two adults aged 31-50, four adults aged 51-65 and one person whose age was unknown. These participants' interest in environmental sustainability varied between our three target groups; eleven participants were interested but unknowledgeable, and eight participants were considered interested and informed. All the participants reviewed the informational posters, tour displays, and the "What am I?" scavenger hunt quiz.

4.5.1 Knowledge Levels of the Survey Participants

Through analysing our pre-surveys, we noticed that the survey participants were moderately knowledgeable about environmental sustainability. Even though the youth did not directly answer the question "What is environmental sustainability?" many indicated that they conserve water and energy and recycle at home. Some youth gave examples of basic sustainable practises such as turning off lights and taps when not in use. Thus, even if they could not state a formal definition of environmental sustainability, they are aware that there are issues in the environment that must be improved.

From the surveys taken by the adult community ages 20-65, we noted a varied knowledge spectrum about environmental sustainability. Individuals who volunteer at the community centre were able to provide a definition for environmental sustainability. Generally, their definitions revolve around saving and protecting the environment. Their answers to questions about water and energy conservation, and even recycling and composting, were a bit more sophisticated than the previously mentioned youth. Instead of just turning off taps and switching off lights, adults mentioned that they save rainwater and shower water for gardening, take shorter showers, turn off appliances instead of putting them on standby, and use insulation

in their homes. One individual, who composts, exclaimed that he has a worm farm to improve the quality of his garden. Very few of the general community members, however, responded in the pre-survey about sustainable features that can be added to homes or ones that are being built into the new classroom. The information from the sample we gathered showed that the members who are actively involved in the community centre are actually somewhat knowledgeable about environmental sustainability and conservation practises, however, they are not aware of the types of materials or features that can be added to buildings.

When compared to the information we gathered from our observations of the youth and our interviews with the Banksia staff, our findings were not completely consistent. Our hypothesis from being acquainted with the youth and community was that many of them were not very informed about environmental sustainability. However, from the pre-surveys, the data we collected showed that at least some members of the adult community understand and acknowledge the concepts and importance of environmental sustainability. We inferred the reason for this discrepancy was due to the fact that the majority of the youth and community members did not feel comfortable participating in our assessment, so we were unable to assess the reactions of disinterested visitors to our displays. However, throughout the assessment process, multiple people in fact stopped to examine the displays we had on exhibit. Thus, having our displays prominently placed in the lobby was effective in attracting people's attention. Also, the population of the community who are actively involved in the community centre are constantly exposed to the concepts of environmental sustainability since the Centre is so immersed in these concepts, having received a grant under the Eco-Living Grant Program funded by the Sustainability Fund since 2008.

After analysing the information from our post-surveys, we concluded that the information from the informational posters and tour displays were able to successfully educate the participants about the concerns about environmental sustainability. There was a range of information people retained from the displays. The feedback from the youth of the community showed that they were not able to develop a formal definition of environmental sustainability

from observing our displays. However, a few of the adult population were able to provide a concise definition. One person was even able to evolve his original definition of energy saving to a definition that made connections between using sustainable materials, technology and ideas to reduce the damaging effects of poor environmental practises. Even though most of our general audience was not able to generate a concrete definition of environmental sustainability from our displays, some people learned about the causes and the detrimental effects of the topics explained by the informational posters. Others learned about how using sustainable materials and upholding sustainable practises are beneficial for the future. However, we do not have sufficient data to conclude that the displays also taught the community about specific, additional sustainable practises that induced behaviour change. Overall, the displays we have created were successful in educating those with limited knowledge of sustainability concepts, if they are sufficiently motivated and interested to read the displays.

4.5.2 Wisdom of the Informed Survey Participants

We identified the people involved in the Introduction to Environmental Sustainability course and the centre's environmental volunteers as our informed audience. Our presumption was further confirmed by the pre-surveys we asked them to complete. Many of their definitions involve using, improving and renewing resources in a way that will enable future generations to live sustainable lifestyles. All of these people apply even more sustainable practises than the general community. These practises include using water- and energy-efficient appliances, using advanced technology such as solar panels and solar water heaters, but also reducing water and energy consumption and recycling and composting materials to reduce landfill waste. Therefore, our informed audience knows the causes, effects and importance of environmental sustainability and are actively reducing their environmental footprints.

Since our informed audience is well informed, the information we gathered from their post-surveys was primarily in the form of feedback and improvements. However, some of them did answer the questions that asked what they learned from the displays. From their responses, we were able to conclude that this audience was able to understand the main message of the

informational posters, which is the cause, effect, and importance of environmental sustainability, and the tour displays, which provide descriptions of the sustainable features implemented around the renovated centre and new classroom. The "Did you know?" facts were, however, new information for some of the people in this group. Some of these individuals also learned new sustainable features they can add to their homes to reduce water and energy consumption, such as water efficient taps and showerheads, solar panels, and deciduous trees. Overall, we concluded that although informed individuals know much of the information from these informational displays, there is still material in our displays that is new to them.

In addition to the feedback on making minor adjustments to the content and wording of our displays, the most important comment made by these respondents were to include displays that incorporated a cost analysis to demonstrate the savings that could result from using efficient and sustainable materials and applying sustainable practises. Another suggestion was to create a display that directly compares the standard way of performing daily routines to the sustainable alternatives. Many of these suggestions have already been considered through other displays that were not included in the assessment.

4.5.3 The Drive for Sustainability

Since many of the general community participants of our assessment were actually fairly knowledgeable about environmental sustainability, we can conclude that there are underlying motivations for them to practise sustainability because many of them stated they applied sustainable practises at home. Data collected from the youth did not reveal the underlying reasons for their sustainable behaviours. As stated in some pre-surveys of the participants from the adult community and the informed participants, a motivation to uphold environmentally sustainable practises are due to government imposed water restrictions and minimising water and electricity bills. However, many of the informed individuals upheld sustainable practises because they acknowledge the importance of water and energy conservation. Additionally, the informed participants are aware of the effects of poor consumption and disposal practises, which are the depletion of water, production of greenhouse gases and build-up of landfills.

Therefore, the motivation of the informed participants is not limited to saving money, but also to improve the current and future quality of the environment.

The results from our post-surveys show that most people are motivated to uphold the sustainable practises they have been practicing. Some informed participants also exclaimed they would look into adding sustainable features into their homes such as insulation, solar panels, water efficient taps and showerheads, and deciduous trees. However, it is difficult to conclude that our displays provided sufficient motivation for future behaviour changes. Therefore, we developed two possible inferences to justify the participants' answers about further applying sustainable practises.

As a result of the success of the Banksia Centre's staff in implementing programs that emphasise environmental sustainability, such as the Eco-Warrior projects, the youth and general community have developed a consciousness for environmental sustainability. We noticed many people reading our displays, even though they did not participate in our survey. By displaying our visually appealing educational tools and making them accessible to the public, we have attracted and encouraged the youth and general community to learn more about environmental sustainability and practise sustainable habits.

Since the informed and motivated participants are already informed and enthused about environmental sustainability, additional motivation is generated from personal interest. By learning about information and practises through our displays, the informed participants may aspire to implement these new ideas because they believe the practises and/or additions will further improve the quality of the environment.

5.0 Conclusion and Recommendations

To spread and enhance the awareness about the importance of environmental sustainability, Banksia Gardens Community Centre is host to a sector of the Eco-Warrior projects. The centre has recently finished renovating the current centre and is in the process of constructing a classroom with sustainable features to teach and encourage the community to be environmentally sustainable. Our goal was to generate educational and interactive displays and activities for Banksia Gardens Community Centre to showcase the sustainable actions they have been taking and to encourage the community to change their behaviours towards sustainability. We created six displays and activities that were strategically devised and chosen to educate the community about the sustainable constructions at Banksia Gardens Community Centre and more about the causes, effects, and initiatives of environmental sustainability. These displays and activities include:

- Promotional posters depicting members of the community who apply sustainable practises,
- Informational posters that contain information about the topics of climate change and biodiversity, energy conservation, water conservation, recycling, composting, and pollution,
- Self-guided tour displays that describe the certain sustainable materials and features located around the centre and classroom,
- A recycling centre painted with pictures showing the different items that go into each corresponding bin,
- A “What am I?” scavenger hunt activity that involves participants finding answers based on information contained in the tour displays, and
- Placement of appropriate plants around the building to improve the air quality and work environment.

Through the assessments of our displays, we made many discoveries and conclusions about the community as well as our displays. With the feedback from the youth and general community participants, we concluded that they were more aware of the concerns with the environment than we originally presumed. By having our displays showcased for the centre, we noticed the displays acted as catalysts that encouraged the community to start thinking about changing their behaviours. The feedback from the informed group provided us with ideas for further recommendations for Banksia Gardens Community Centre.

5.1 Recommendations for Banksia Gardens Community Centre

Overall, the initiative of our tools has been successful for environmentally educating its audience causing them to start thinking critically about their actions and encouraging them to start changing their behaviours. We believe that the continuous development of displays like these will open many doors for the future.

- **Educational and Interactive Displays and Activities:** From observing that our displays and activities "got the centre talking" about sustainability, we concluded that making more educational and interactive displays and activities will get the community more excited about sustainability and teach them at the same time. We recommend for the Centre to continue developing the remaining eighteen displays and activities we brainstormed. These ideas can be found in Appendix J.
- **Relating Environmental Sustainability to Cultures:** Through our time working at the Centre and the interviews conducted with the Banksia staff, we noticed that the Broadmeadows community is very culturally diverse. We believe it would be beneficial to generate seminars for various cultural groups to relate sustainable practises to their unique cultural routines to allow the people to relate and understand how sustainable practises can be very beneficial to their lives. For example, the Turkish members are keen on cooking at the centre, so we suggest holding a seminar for them to learn about

food miles and how a community garden can reduce the cost of production of food and save them money as well as the environment.

- **Interactive Eco-Warrior Holiday Program Sessions:** We learned through our research and noticed through our observations at the Eco-Warrior sessions of the holiday programs that the youth learn better through engagement and hands-on activities. For this we recommend developing sustainability courses for the summer holiday programs that involve more interactive activities such as games and competitions rather than strict lecture-style teaching.
- **Partnerships:** We recommend that the Centre work in partnership with local schools to organise excursions to the community centre. The youth can be guided through tours, participate in the activities that were created through our project, and learn about environmental sustainability. These partnerships can be beneficial for local schools to see the initiative Banksia Gardens Community Centre has taken towards a sustainable future and to encourage them to start taking action as well.
- **Money Money Money:** From learning about the overall community, we realised money was a major motivator for the community. For this reason we suggest that the Centre and the Eco-Warriors teach the community about affordable, sustainable practises that help them save money. The fact that money saved in the long-term will outweigh the initial money spent should also be emphasised.
- **Future WPI Projects:** Banksia Gardens Community Centre has great potential to continue collaborating with future WPI project teams. One suggestion for a future team is to conduct a cost analysis for the Centre before and after its renovations and addition of the new classroom. This cost analysis is expected to show the money saved through the long-term use of the sustainable features. The team can further use this cost analysis to create interactive displays to demonstrate how the Centre's renovations have saved money. These displays can be used to support the Centre's work in the instillation of sustainable mindsets within its community members.

We believe the work we have done is only the beginning to a prosperous future for Banksia Gardens Community Centre. From our project, there are multiple opportunities for the Centre to continue developing sustainable attitudes and continue being recognised for their passion and devotion to developing an environmentally friendly community.

Glossary and Acronyms

Acrylic – A type of plastic

Air pollution - Contaminants in the air

Atmosphere – The gaseous envelope the surrounds the Earth

AUD – Australian Dollar

BGCC – Banksia Gardens Community Centre

Benzene – A colourless, volatile, flammable, toxic chemical compound (chemical formula: C_6H_6)

Biodiversity – The variety of living things on Earth, and their interactions

Black absorbers – Black bodies that absorb the sun's heat radiation

Black glass – Tinted glass

Bleaching – The whitening or killing of coral primarily due to increased sea temperatures

BREEAM – Building Research Establishment Environmental Assessment Method is the program used in the United Kingdom to measure the sustainability of a building

Bring-schemes – Recycling system with destinations for participants to drop off recycling

CALD – Culturally and Linguistically Diverse

Capitalistic globalisation trends - Regional economies, societies, and cultures have become integrated into a global network through communication, transportation, and trade

Carbon dioxide – A colourless, odourless, incombustible gas present in the atmosphere and formed during respiration, also increased levels in the atmosphere are believed to be a significant contributor to climate change (chemical formula: CO_2)

Ceiling baffles – Also known as rafter vents, ventilate an area so that moisture doesn't get trapped in the space and so that the air stays fresh

Cellulose – Carbohydrate that makes up the cell wall of plants (chemical formula: $C_6H_{10}O_5$)

CH2 – Council House 2

Climate change – Long-term change in weather patterns that is partially due to human interactions

Clerestory structures – Windows placed at the top of a wall and arranged in rows to create a solid band of light into a room without compromising privacy

Composting – Mixture of decaying organic materials that can be used as fertiliser

Contamination – An unclean substance that makes an area impure

Coolaroo – White knitted fabric used as a window blind

CSIRO – Commonwealth Scientific and Industrial Research Organisation

Deciduous trees – A tree that sheds leaves depending on the season

Direct observations – Directly observing a group

DNA – Deoxyribonucleic Acid

Double-glazed windows – Windows made with two panes of glass to reduce heat transfer

Down-cycled – Recycling a material to degraded form of its original component

DSD – Dual System Deutschland Corporation

Dual flush toilets – Toilets that use two different buttons to flush different amount of water based on the type of excretion

Dual System Deutschland Corporation - A system in Germany that collects and disposes of packaging for the packaging companies

Dynamo – A generator that creates an electrical current

E-film – A thin sheet of a clear plastic material that is put over windows to help insulate a building by preventing heat transfer

Ecosystem – An area where living and non-living organisms work together in close quarters

Ecosystem diversity – An area made up of several ecosystems

Eco-friendly – Healthy for the environment

Eco-Warriors – An organisation that works to improve local awareness of the serious global destruction, and educated residents about sustainable options

EMT – Executive Management Team

Energy consumption –Energy used by a person or a group over a specific duration of time

Environmental footprint – A measure of the negative impacts a human has created on the environment

EPS – Polystyrene-Expanded Foam Insulation

Evapotranspiration – The movement of water through the pant into the atmosphere

Environmental sustainability – Developing a place that does not borrow, destroy, or exhaust natural resources in such a way the harmfully affects the environment, or prevents or inhibits future generations from using such resources

Electrons – Negatively charged particles

Enhanced greenhouse effect – Heightened densities of green house gas absorbing and re-emitting heat energy toward the Earth. The high density of greenhouse gas is due to human contamination.

Evaporation – The process of H_2O turning from its liquid state into its gaseous state

Fluorescent light bulbs – Light bulbs that use electrodes to send a stream of electrons through mercury vapour, which produces ultraviolet photons. These ultraviolet photons collide with the phosphor coating on the inside of the bulb and produce visible light.

Food miles – The distance between where the product is consumed and produced

Formaldehyde – A colourless, toxic, potentially carcinogenic, water-soluble gas, having a suffocating odour used primarily as a disinfectant or preservative (chemical formula: CH_2O)

Fossil fuels – Any combustible organic material, such as oil, petrol, and coal

GBCA – Green Building Council Australia

Genetic diversity – The difference in DNA between organisms or species

Gray water - Waste water created by human activities, such as washing dishes, a car, or doing your laundry

Green – Betterment of the environment

Greenhouse gases – Gasses in the atmosphere that have the ability to absorb and re-emit heat energy

Green Star – The program used in Australia to measure the sustainability of a building

Halogen light bulbs – Light bulbs that produce by heating filament until it turns white hot, much like incandescent bulbs, but are more efficient than incandescent bulbs because they use tungsten filament, extreme heat, and halogen gases. The combination of extreme heat and halogen gases redeposit the evaporating tungsten atoms back onto the filament

Holliday programs – Programs that Banksia Gardens run during the summer months for the youth

Human waste – Waste directly created by humans

Incandescent light bulbs – Light bulbs that produce light by heating a filament until it glows white-hot

Indoor pollutants – Chemicals created through consumer products, which are in homes and businesses

Infrared radiation – Heat energy

IQP – Interactive Qualifying Project

Kerbside collection – Recycling system that picks up recycled materials from bins placed on the curb

KGOE – Kilograms of Oil Equivalent

Kinaesthetic learning – Learning through physically activities

Landfills – A place where rubbish is disposed of by burying it under layers of earth

LCD – Liquid Crystal Display

LEED – Leadership in Energy and Environmental Design is the program used in the United States to measure the sustainability of a building

MDF – Medium–Density Fibreboard

Methane- A colourless, odourless, flammable gas (chemical formula: CH_4)

Mobius shape – A shape with no ends

Natural lighting – Light from the sun

Nitrous oxide – A colourless, sweet-smelling, sweet-tasting, non-flammable gas used primarily as an anaesthetic or aerosol

Pairwise comparison chart – A chart that compares two entities to determine which entity is more preferred

Participant observations - Observation made through by directly participating with a group in activity or event

Photon – A unit of light

Photovoltaic effect – Method of generating electrical power by converting solar radiation into direct current electricity

Photovoltaic thermal (PVT) – Hybrid solar panel that captures the suns heat radiation converts some to electricity and use

Photovoltaic solar panels (PV) – Converts sunlight directly into electricity

Pollution – Introduction of harmful substances into the environment

Potable water – Fresh water; water humans can drink

Precipitation - Water falling towards the Earth, usual as snow rain, sleet or hail

Recycling – The reuse or renewing of products

Roof monitors- A roof with a raised extension above a ridge that can provide light and ventilation to the room below

Raw materials – Unprocessed materials

Scienceworks Museum – Science museum located in Victoria

Sick building syndrome (SBS) - An illness due to toxins produced in buildings

Sheathing – A thin board, like plywood, used on the roof floors interior and exterior of walls

Solar energy – Energy created by capturing solar radiation

Solar irradiance – The amount of solar energy in a specific place at a specific time

Solar panels – Panels that turn the suns energy into usable energy

Solar radiation – Energy emitted by the sun

Solid waste – All waste materials in their solid form, otherwise known as rubbish

Species diversity – The total number of different species within a habitat

SPF – Spray Polyurethane Foam Insulation

Storm water collection tanks/ rainwater collection tanks – Tanks used to collect rainwater

Sustainable – The relationship between economic, environmental, and community development

Thermal solar panels- solar panels that capture the suns heat radiation and use it to heat water

Toepfer Decree – Plan implemented in Germany to reduce the amount of plastic being put into landfills.

Transpiration – See Evapotranspiration

Trichloroethylene - A toxic liquid often used to break down oils or fats

Tri-generator - Simultaneous production of electricity, heat, and cooling from a single heat source such as fuel or solar energy

Urea-formaldehyde – Toxic adhesive used in some types of sheathing

USD – United States Dollar

Volatile organic compounds (VOCs) – Organic chemicals which can significantly affect the health of humans and the environment

Waste management – The process of monitoring the waste exposed, being aware that the correct materials are recycled and composed

Water consumption – The amount of water used by a person or group over a specific duration of time

WPI – Worcester Polytechnic Institute

XPS – Polystyrene-Extruded Foam Insulation

References

Abdullah, M. H. (2001). Self-Directed Learning. ERIC Digest. *ERIC Clearinghouse on Reading, English, and Communication, 169*.

Aiman-Smith, L., & Markham, S. K. (2004). What you should know about using surveys. *Research-Technology Management, 47*(3), 12-15.

Ambius. (2010). *Benefits of Plants in Buildings* Retrieved 1/31/2011, from http://www.ambiusindoorplants.com.au/indoor-plant-information/benefits-of-plants-in-buildings/index.html

American Association for the Advancement of Science. (2000). *Population and Natural Resources.* Retrieved 02/20/2011, from http://atlas.aaas.org/index.php?part=2

Armstrong, H. G. (2005). Environmental education in Tobago's primary schools: a case study of coral reef education.

Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative data: An introduction to coding and analysis.* NYU press.

Australian Bureau of Statistics. (2008). *Public Transportation Use for Work and Study.* Retrieved 01/30/2011, from http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Chapter10102008

Australian Government: Bureau of Meteorology. (2010). *Climate Change* Retrieved 1/31/2011, 2011, from http://www.bom.gov.au/climate/change/

Australian Government: Department of Climate Change and Energy Efficiency. (2011). *Australia's Biodiversity and Climate Change* Retrieved 1/31/2011, from http://www.climatechange.gov.au/publications/biodiversity/biodiversity-climatechange.aspx

Australian Government: Department of Climate Change and Energy Efficiency. (2011). *What is climate change?.* Retrieved 1/31/2011, from http://www.climatechange.gov.au/climate-change.aspx

Australian Government: Department of Sustainability, Environment, Water, Pollution and Communities. (2011). *Indoor air* Retrieved 1/31/2011, from http://www.environment.gov.au/atmosphere/airquality/indoorair/index.html

Australian Museum. (2011). *What is biodiversity?* Retrieved 1/31/2011, from http://australianmuseum.net.au/What-is-biodiversity

Babcock, Joshua. (2008). *Guelph Rainwater Research.* Retrieved 12/04/2010, from http://www.brokencitylab.org/blog/guelph-rainwater-research/

Banksia Gardens Community Centre. (2010). Retrieved 10/29/2010, from http://www.banksiagardens.org.au/index.php

Baulch, H., Pisupati, B., & Reid, H. (2004). *How Biodiversity and Climate Change Interact* Retrieved 2/3/2011, from http://www.scidev.net/en/climate-change-and-energy/climate-change-in-india/policy-briefs/how-biodiversity-and-climate-change-interact.html

Behrens, A., Giljum, S., Kovanda, J., & Niza, S. (2007). The material basis of the global economy: Worldwide patterns of natural resource extraction and their implications for sustainable resource use policies. *Ecological Economics, 64*(2), 444-453.

Benifits of Recycling. (2010). *Interesting Facts about Recycling In Australia.* Retrieved 02/04/2011, from http://www.benefits-of-recycling.com/interestingfactsaboutrecycling.html

Brown, M. (2011). *Audio Versus Visual Learning.* Retrieved 02/21/2011, from http://www.ehow.com/about_5263298_audio-versus-visual-learning.html

Burley, S. (2009). *Photovoltaic Modules vs. Solar Thermal Collectors: Which Types of Solar Panels for Your Home Yield the Most Benefits?* Retrieved 12/07/2010, from http://www.brighthub.com/environment/renewable-energy/articles/9712.aspx

Cali Bamboo. (2010). *Why Bamboo?* Retrieved 02/04/2011, from http://www.calibamboo.com/whybamboo.html

Chiras, D. D. (2000). *The natural house: a complete guide to healthy, energy-efficient, environmental homes* Chelsea Green.

City of Melbourne. (2011). *Bicycle Plan.* Retrieved 2/20/2011, from http://www.melbourne.vic.gov.au/AboutCouncil/PlansandPublications/strategies/Pages/Bikeplan.aspx

Clean Air Plants & Sick Building Syndrome. Retrieved 1/31/2011, from http://www.oxford.net/~steve/sick.htm

Cleaner Climate. *What is Climate Change* Retrieved 1/31/2011, from http://www.cleanerclimate.com/useful-information/what-is-climate-change

Cloud, A. (2005). Educating for a Sustainable Future. *Australian Government, Department of Environment and Heritage.*

Clover, D. E. (2003). Environmental adult education: Critique and creativity in a globalizing world. *New Directions for Adult and Continuing Education, 2003*(99), 5-15.

Colleran, C. (2009). *Energy Consumption Breakdown.* Retrieved 12/06/2010, from http://www.buildgreenbloghiltonhead.com/home/2009/8/26/energy-consumption-breakdown.html

Corral-Verdugo, V. (2003). Situational and personal determinants of waste control practices in northern Mexico: a study of reuse and recycling behaviors. *Resources, Conservation and Recycling, 39*(3), 265-281.

Craven, J. (2003). *The healthy home: beautiful interiors that enhance the environment and your well-being.* Quarry Books.

CSIRO. (2007). *Pollution.* Retrieved 02/04/2011, from http://www.csiro.au/org/PollutionOverview.html

Cuthill, M. (2002). Exploratory research: citizen participation, local government and sustainable development in Australia. *Sustainable Development, 10*(2), 79-89.

Dagostino, Frank R., Peterson, Steven J. (2010). Wood. *Estimating in Building Construction* (7th ed., pp. 154-155, 162, 163, 168). New Jersey: Pearson.

Davis, J. (1998). Young children, environmental education, and the future. *Early Childhood Education Journal, 26*(2), 117-123.

Department of Climate Change and Energy Efficiency. (2010). *Living Greener.* Retrieved 12/10/2010, from http://www.livinggreener.gov.au/

Dietz, T., & Stern, P. C. (2002). *New tools for environmental protection: education, information, and voluntary measures* National Academies Press.

Edwards, L., Torcellini, P. A., & National Renewable Energy Laboratory (US). (2002). *A literature review of the effects of natural light on building occupants*.

Elliott, S. (2010). Essential, Not Optional: Education for Sustainability in Early Childhood Centres. *Exchange, 192*, 34-37.

Elliott, S. (2010). *How Dual Flush Toilets Work.* Retrieved 11/25/2010, from http://home.howstuffworks.com/dual-flush-toilet.htm

Elliott, S., & Davis, J. (2009). Exploring the resistance: An Australian perspective on educating for sustainability in early childhood. *International Journal of Early Childhood, 41*(2), 65-77.

Ernst, J. A. (2007). Persistence in Implementing EE: Implications for the Interpretive. *Interpretation,* , 51.

Ewan, K. B. R., & Pamphlett, R. (1996). Increased inorganic mercury in spinal motor neurons following chelating agents. *Neurotoxicology, 17*(2), 343-349.

Farwell, T. (2011). *Visual, Auditory, Kinesthetic Learners.* Retrieved 2/21/2011, from http://school.familyeducation.com/intelligence/teaching-methods/38519.html

First Glass Double Glazing. (2011). Retrieved 02/04/2011, from http://www.articlesbase.com/diy-articles/first-glass-double-glazing-4159531.html

Gale Pacific. (2006). *Coolaroo: The coolest protection under the sun.* Retrieved 03/01, 2011, from http://www.coolaroo.com/

Goodland, R. (1995). The concept of environmental sustainability. *Annual Review of Ecology and Systematics, 26*, 1-24.

Green Home Guide Staff. (2009). *Buyer's Guide to Green Insulation.* Retrieved *11/30/*2010, from http://greenhomeguide.com/know-how/article/buyers-guide-to-green-insulation

Green, M. A., Emery, K., Hishikawa, Y., & Warta, W. (2009). Solar cell efficiency tables (version 34). *Progress in Photovoltaics: Research and Applications, 17*(5), 320-326.

Gubrium, J. F., & Holstein, J. A. (2002). *Handbook of interview research: Context & method* Sage Publications, Inc.

Helden, W. G. J., Zolingen, R. J. C., & Zondag, H. A. (2004). PV thermal systems: PV panels supplying renewable electricity and heat. *Progress in Photovoltaics, 12*(6), 415-426.

Holt, S. (2008). *Trends in Australia's Energy Consumption* Melbourne: Department of the Environment, Water, Heritage and the Arts.

Hopewell, J., Dvorak, R., & Kosior, E. (2009). Plastics recycling: challenges and opportunities. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364*(1526), 2115.

How do Photovoltaic Panels Really Work. (2009). Retrieved 02/20/2011, from http://renaissanceronin.wordpress.com/2009/04/

HowStuffWorks. (2000). *How does a halogen light bulb work?* Retrieved 12/08/2010, from http://home.howstuffworks.com/question151.htm

International Energy Agency. (2007). *Energy and Resources- Energy Consumption: Total energy consumption per capita.* Retrieved 2/21/2011, from http://earthtrends.wri.org/searchable_db/results.php?years=2005-2005&variable_ID=351&theme=6&cID=9&ccID=0

Kampa, M., & Castanas, E. (2008). Human health effects of air pollution. *Environmental Pollution, 151*(2), 362-367.

Kinesthetic Learner Characteristics. (2011). Retrieved 02/21/2011, from http://www.emporia.edu/csi/studentsuccess/documents/KinestheticLearner.pdf

Knier, G. (2002). *How do Photovolatics Work.* Retrieved 02/20/2011, from http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/

Kofoworola, O. (2007). Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria. *Waste Management, 27*(9), 1139-1143.

Kuo, C. Y., Wong, R. H., Lin, J. Y., Lai, J. C., & Lee, H. (2006). Accumulation of chromium and nickel metals in lung tumors from lung cancer patients in Taiwan. *Journal of Toxicology and Environmental Health, Part A, 69*(14), 1337-1344.

Lasley, S. M., & Gilbert, M. E. (2000). Glutamatergic components underlying lead-induced impairments in hippocampal synaptic plasticity. *Neurotoxicology, 21*(6), 1057-1068.

Lee, Hao; Personal communication, 26 January 2011.

Lewis, N. S. (2007). Toward cost-effective solar energy use. *Science (Washington), 315*(5813), 798-801.

Li, Z., Rose, J., & Hensher, D. (2009). *Petrol consumption and emissions from automobiles: Can policies make a difference?* (Unpublished Transport and Logistics Management). University of Sydney, Australian Research Council's Key Centre Program. (1832-570X)

Liverpool City Council. (2011). *Pollution.* Retrieved 02/04/2011, from http://www.liverpool.nsw.gov.au/pollution.htm

Living Green. (2010). *Green Vs. Sustainable; The Difference.* Retrieved 12/13/ 2010, from http://www.gogreenstreet.com/green-vs-sustainable-the-difference/

London Hazards Centre. (1990). Causes of Sick Building Syndrome (Chapter 4). Retrieved 1/31/2011, from http://www.lhc.org.uk/members/pubs/books/sbs/sb04.htm

Mahaffy, M. (1999). *Defining Sustainability.* Retrieved 11/15/2010, from http://www.arch.wsu.edu/09%20publications/sustain/defnsust.htm

Maxwell, J. A. (2005). *Qualitative research design: An interactive approach* Sage Publications, Inc.

Means, R. (2002). Green Building: Project Planning & Cost Estimating.

Melbourne Water. (2010). *Water use at home, daily use for Melbourne.* Retrieved 12/08/ 2010, from http://www.melbournewater.com.au/content/water_conservation/water_use/water_use.asp?bhcp=1

Merriam, S. B. (2001). Andragogy and Self-Directed Learning: Pillars of Adult Learning Theory. *New Directions for Adult and Continuing Education, 2001*(89), 3-14.

Mickey, Z. (2011). *Green Glossary: Downcycling - Planet Green* Retrieved 2/20/2011, from http://planetgreen.discovery.com/work-connect/green-glossary-downcycling.html

Mifflin, M. *Ceiling Fan Rotation - Which Way Should the Ceiling Fan Rotation be Set?* Retrieved 1/31/2011, from http://housewares.about.com/od/coolingheating/f/ceilfanrotation.htm

Museum Victoria. (2011). *Scienceworks: About Us.*, Retrieved 1/31/2011, from http://museumvictoria.com.au/scienceworks/about-us/

National Asthma Council Australia. (2005). *Health Effects of Indoor Air Pollution*, 1/31/2011, from http://www.nationalasthma.org.au/content/view/41/101/

Natural Health Restored. (2010). *Benefits of Sunlight.* Retrieved 02/04/2011, from http://www.natural-health-restored.com/benefits-of-sunlight.html

Norwood Industries. (2003). Cocos Palm Pushin Lable. Hallam Victoria Australia, from www.norwood.com.au

Norwood Industries. (2008). Flamingo Flower Pushin Lable. Hallam Victoria Australia, from www.norwood.com.au

Norwood Industries. (2009). Flamingo Flower Pushin Lable. Hallam Victoria Australia, from www.norwood.com.au

NSW Department of Primary Industries. *Causes of climate change.* Retrieved 1/31/2011, from http://www.dpi.nsw.gov.au/research/topics/climate-change/causes

Olson, S. L., & Kellum, S. (2003). The impact of sustainable buildings on educational achievements in K-12 schools. *Leonardo, 2*

Omer, A. M. (2008). Energy, environment and sustainable development. *Renewable and Sustainable Energy Reviews, 12*(9), 2265-2300.

Palmer, J. (1998). *Environmental education in the 21st century: Theory, practice, progress and promise* CRC Press.

Papadopoulos, A., & Giama, E. (2007). Environmental performance evaluation of thermal insulation materials and its impact on the building. *Building and Environment, 42*(5), 2178-2187.

Patton, M. Q. (1987). *How to use qualitative methods in evaluation.* Sage Publications, Inc.

Perez-Lombard, L., Ortiz, J., & Pout, C. (2008). A review on buildings energy consumption information. *Energy and Buildings, 40*(3), 394-398.

Pirog, R. (2003). *Checking the food odometer: Comparing food miles for local versus conventional produce sales to Iowa institutions.* (Agricultural and Biosystems Engineering). Iowa State University, Iowa State University.

Planet Green. (2009). *How to Go Green: Public Transportation.* Retrieved 01/30/ 2011, from http://planetgreen.discovery.com/go-green/public-transportation/

Planet Green. (2009). *How to go Green: Recycling* Retrieved 12/02/2010, from http://planetgreen.discovery.com/go-green/recycling/

Planet Green. (2010). *6 Tips to Go Car Free on World Car Free Day.* Retrieved 01/30/2011, from http://planetgreen.discovery.com/tech-transport/6-tips-to-go-car-free-on-world-car-free-day.html

Pooley, J. A., & O'Connor, M. (2000). Environmental education and attitudes. *Environment and Behavior, 32*(5), 711.

Poudel, D., Vincent, L., Anzalone, C., Huner, J., Wollard, D., Clement, T., DeRamus, A., & Blakewood, G. (2005). Hands-on activities and challenge tests in agricultural and environmental education. *The Journal of Environmental Education, 36*(4), 10-22.

Ratnaike, R. N. (2003). Acute and chronic arsenic toxicity. *Postgraduate Medical Journal, 79*(933), 391.

Reynolds, S. P. (1995). The German Recycling Experiment and Its Lessons for United States Policy. *6*, 43.

Rindt, Santbergen and Zolingen. (2005). *Photovoltaic/Thermal Combi-Panels Generating Both Solar Electricity*

and Heat. Retrieved 02/20/2011, from http://docs.google.com/viewer?a=v&q=cache:-S-gftQLV-QJ:w3.wtb.tue.nl/fileadmin/wtb/wtb_energytechnology/poster_Rudi1.pdf+photovoltaic+t

hermal+\panels&hl=en&gl=us&pid=bl&srcid=ADGEESguhH_qIFuDBNbo9qXfcNWUsUmuD71lmneBzfYovqtUnSZ2OMuT0P-_0sW3XWZBTItDoJwevQrlDWFz6BTGu3iQ6LWmTsEK2YYD4TpuqpLf9umVzar6y49sCvxttn0C8Mkq7-cO&sig=AHIEtbSsHmT8jqJQ2PDb7RCZT3AQhkTnVg

Rivera-Rentas, A., Vilches, M., Davila, E., Rebollo, C., Rodriguez, M., Garcia, J., & Seguinot, S. (2007). Environmental awareness through integration of research and education: a case study from two elementary public schools in Puerto Rico. *International Journal of Environment and Pollution, 31*(3), 359-370.

Smith, S. E. (2010). *What is Window Glazing?* Retrieved 12/05/2010, from http://www.google.com/url?q=http%3A%2F%2Fwww.wisegeek.com%2Fwhat-is-window-glazing.htm&sa=D&sntz=1&usg=AFQjCNFts0R247Os2DR02y5kxas7OUOMPg

Solar Power. (2010). Retrieved 02/20/2011, from http://www.ultimate-handyman.com/solar-power/

Stapp, W. B., Bennett, D., Bryan, W., & Fulton, J. (1970). The concept of environmental education. *The American Biology Teacher, 32* (1), 14-15.

State Government Victoria. (2010). *Melbourne Bike Share.* Retrieved 2/20/2011, from http://www.melbournebikeshare.com.au/

Steinfeld, C. (2001). A Bamboo Future. *Environmental Design and Construction,* features BNP, 1-5.

The Garden of Oz. (2009). *The Basics of Composting.* Retrieved 11/30/2010, from http://www.thegardenofoz.org/composting101.asp

The State of Victoria. (2010). *Sustainability.* Retrieved 11/15/2010, from http://www.dse.vic.gov.au/dse/nrence.nsf/childdocs/-51B7A26E5FB2257B4A2567CB000310AF?open

Thomsen, D. (2008). Community-based research: Facilitating sustainability learning. *Australasian Journal of Environmental Management, 15*(4), 222.

Tilbury, D. (2004). Rising to the challenge: education for sustainability in Australia. *Australian Journal of Environmental Education, 20*(2), 103-114.

Toothman, J., & Aldous, S. (2010). *How Solar Cells Work.* Retrieved 12/05/2010, from http://www.google.com/url?q=http%3A%2F%2Fscience.howstuffworks.com%2Fenvironmental%2Fenergy%2Fsolar-cell.htm&sa=D&sntz=1&usg=AFQjCNEeQlAenb_hUDM4_AIGDqSl7YVl6w

TopBits. (2010). *How Insulation Works.* Retrieved 12/05/2010, from http://www.google.com/url?q=http%3A%2F%2Fwww.tech-faq.com%2Fhow-insulation-works.html&sa=D&sntz=1&usg=AFQjCNFAmNsF0TTvGYXgzIlzvcJbkOLbEA

Twiss, J., Dickinson, J., Duma, S., Kleinman, T., Paulsen, H., & Rilveria, L. (2003). Community gardens: lessons learned from California Healthy Cities and Communities. *American Journal of Public Health, 93*(9), 1435.

United States Environmental Protection Agency. (2010). *An Introduction to Indoor Air Quality (IAQ): Formaldehyde.* Retrieved 12/13/2010, from http://www.epa.gov/iaq/formalde.html

United States Department of Energy. (2010). *Energy Savers.* Retrieved 12/01/2010, from http://www.energysavers.gov/tips/

United States Environmental Protection Agency. (2010). *Energy Star Light Bulbs.* Retrieved 12/05/2010, from http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=LB

United States Environmental Protection Agency. (2010). *Wastes - Resource Conservation - Reduce, Reuse, Recycle.* Retrieved 12/2/2010, from http://www.epa.gov/osw/conserve/rrr/recycle.htm

University of Michigan. (2006). *Human Appropriation of the World's Fresh Water Supply.* Retrieved 11/21/2010, from http://www.globalchange.umich.edu/globalchange2/current/lectures/freshwater_supply/freshwater.html

Victorian Government Department of Sustainability and Environment. (2009). *Achieving Target 155* 8 Nicholson Street, Melbourne: Victorian Government Department of Sustainability and Environment.

Vlek, C., & Steg, L. (2007). ⊡Human Behavior and Environmental Sustainability: Problems, Driving Forces, and Research Topics. *Journal of Social Issues, 63*(1), 1-19.

Wakefield, S., Yeudall, F., Taron, C., Reynolds, J., & Skinner, A. (2007). Growing urban health: community gardening in South-East Toronto. *Health Promotion International, 22*(2), 92.

Walkowiak, J., Wiener, J. A., Fastabend, A., Heinzow, B., Krämer, U., Schmidt, E., . . . Winneke, G. (2001). Environmental exposure to polychlorinated biphenyls and quality of the home environment: effects on psychodevelopment in early childhood. *The Lancet, 358*(9293), 1602-1607.

White, S. (2001). Demand management and integrated resource planning in Australia. Paper presented at the *Proceedings, Efficient use and Management of Water for Urban Supply Conference. Madrid.*

White, S., & Fane, S. (2002). Designing cost effective water demand management programs in Australia. *Water Science & Technology, 46*(6), 225-232.

Whiteley, C. I. (2011). *Floor-ceiling air circulating device.* Retrieved 1/31/2011, from http://www.google.com.au/patents?hl=en&lr=&vid=USPAT3973479&id=z60rAAAAEBAJ&oi=fnd&dq=circulating+air+through+ceiling+fans&printsec=abstract#v=onepage&q=circulating

Wolverton, B. C. (1997). *How to grow fresh air: 50 houseplants that purify your home or office* . New York, N.Y.: Penguin Books.

Wood, E., Pan, M., & Sheffield, J. (2009). A Testbed for Integrated Water Cycle Observations: A Grand Challenge for the Community.

Worm, J., & van Hattum, T. (2006). *Rainwater harvesting for domestic use.* Agromisa Foundation.

Wrigley, Derek. (2005). *Making Your Home Sustainable: A Guide To Retrofitting*. Carlton North, Victoria, Australia: Scribe Publications.

Zheng Li, John M. Rose and David A. Hensher. (2009). *Petrol consumption and emissions from automobiles: Can policies make a difference?* (Unpublished Transport and Logistics management). University of Sydney, Australian Research Council's Key Centre Program. (1832-570X)

Appendix A: Sponsor Description

The Banksia Gardens Community Centre provides an interactive and supportive atmosphere for people of all ages and backgrounds. It is located in the City of Hume as a part of the Broadmeadows housing development. During the 1970s, the Ministry of Housing responded to the need for housing in the Broadmeadows area by constructing a public housing estate. Upon completion, the community lobbied the Ministry of Housing for a unit to be used as a community centre, thus the Banksia Gardens Community Centre was born.

When the Community Centre was established in 1981, it provided a place for people in need of support. Single parents, young couples, low-income families, and foreigners gathered here for various helpful community programs. Some of these programs included youth groups, camps, and women's support groups. The centre sent out newsletters periodically to the community to keep them updated on the different programs. Over time, this community captured interest from its residents and evolved to what it is now.

Currently, the Community Centre offers programs to the entire Broadmeadows community. These programs range from breakdancing to cultural awareness activities to environmental studies. There are also after school programs that include art workshops, field trips, sports, music and other engaging educational and recreational activities. A more serious program, called the "Building Bridges" project engrosses the community in different activities that teach about the local cultural diversity. These events aim to promote cultural awareness and harmony within the community. One integral program that is part of the Banksia Community is the Banksia Eco-Warriors: Community Empowerment for a Green Tomorrow.

The Eco-Warrior project series was created to address the problems of environmental sustainability. The primary problem the Eco-Warriors face is the community's lack of awareness of the seriousness of global destruction and educating residents about the possible options of sustainability. The Eco-Warriors' (and global community's) ultimate goal is to develop a community that does not borrow, destroy, or exhaust natural resources in such a way that

harmfully effects the environment, or prevents or inhibits future generations from using such resources. The Eco-Warriors have developed the Building Demonstration Program to inspire community awareness about sustainability and to address the problem head on by renovating its current facilities and constructing a new sustainable classroom. The Building Demonstration Program aims to create interactive tools to educate the Banksia community and their youth about the importance of environmental sustainability. The Banksia Eco-Warriors will also be presenting these informative materials in the new sustainable classroom.

The Banksia Gardens Community Centre has come a long way since its inception. From a community tailored to supporting the needs of the less fortunate, it has blossomed into an environment that not only supports each member of the community but also offers various constructive programs enhance the greater community.

Appendix B: Green Star

In 2002 the Green Building Council Australia (GBCA) was created. This non-profit organisation has devoted itself to make Australian industry more sustainable. In order for the GBCA to reach this goal, it launched a program called Green Star in 2005. Green Star sets the standards and a common language for sustainable building and works to identify and promote the construction choices needed to make a building "green" (Green Building Council Australia, 2010).

The GBCA created the Green Star building rating system by taking ideas from the United State's Leadership in Energy and Environmental Design (LEED) program, and the United Kingdom's Building Research Establishment Environmental Assessment Method (BREEAM). Like these programs, Green Star rates the sustainable buildings by awarding points for incorporating different aspects of sustainability into a building. There are nine different categories, which Green Star looks at when rating a building. These categories are management, energy, water, indoor environment quality, transport, land use and ecology, materials, emission and innovation. Each category is broken down into credits, which are received based on items put into the building in order to enhance its overall sustainable quality (Green Building Council Australia, 2010).

When a building gets assessed it is compared with the Green Star credits to determine which credits the building achieved. Each credit is evaluated and tabulated in order and based on the number of credits the building is awarded category points. Each category is calculated with the formula:

$$Category\ Score = \frac{No.\ of\ Points\ Achieved}{(No.\ of\ Points\ Available \bullet 100\%)}$$

Figure 12: Green Star Category Score (Green Building Council Australia, 2010)

After the category score has been determined, an Environmental Weighting Factor is added to each category. The weights were determined with input from multiple organisations including

CSIRO, Australian Greenhouse Office, and the Commonwealth Department of Environment and Heritage. The purpose of the Environmental Weighting Factor is to balance out any issue that was created from the points scale. It is used along with the category score in order to find the weighted category score. The weighted category score is found using the formula: (Green Building Council Australia, 2010).

$$Weighted\ Category\ Score = \frac{(Category\ Score\% \bullet Weighting\ Factor\%)}{100}$$

Figure 13: Environmental Weighted Factor (Green Building Council Australia, 2010)

The weighted category scores are added together to find the overall points the building obtained. Depending on the number of points awarded the building will receive between one and six stars. Table 1 shows the number of points the building needs to receive for each star category (Green Building Council Australia, 2010).

Number of Stars	Number of Points	Award Level
One Star	10-19 Points	
Two Stars	20-29 Points	
Three Stars	30-44 Points	
Four Stars	45-59 Points	Best Practise
Five Stars	60-74 Points	Australian Excellence
Six Stars	75+ Points	World Leader

Table 1: Green Star Levels and Ratings (Green Building Council Australia, 2010)

Appendix C: Further Information on Composting

Composting can reduce the amount of solid waste in landfills and can be used to fertilise gardens and lawns. To create the best compost pile, the waste must be four parts brown and one part green. Brown materials are materials like dry leaves, dried grass, cornstalks, and saw dust, while green materials are grass clippings, green leaves, weeds, and trash from the kitchen like fruits, vegetables and tea bags (The Garden of Oz, 2009).

There are two types of compost piles, open bin composting and compost containers. Each has their advantages and disadvantages but work similarly. Open bin composting can collect necessary water during rainstorms and be easily added to but can attract unwanted pests and become too wet (The Garden of Oz, 2009). Closed compost containers keep unwanted pests out but require the addition of water. Both open and closed composting piles will yield the same results but should not be added to once decomposition starts. Decomposition of compost takes several weeks to complete. Adding more material to the compost pile before the previous compost fully decomposes will cause a mix of compost. This is not ideal for composting because it is difficult to determine when the compost can be used for fertiliser. To solve this problem, compost containers generally have two chambers for use (The Garden of Oz, 2009).

There are also two types of composting, hot and cold composting. Hot composting is also known as aerobic composting and is usually the more efficient form of composting. These composting piles can reach temperatures around 160 degrees Fahrenheit, keeping out unwanted pests. Hot composting requires a shorter period than cold composting, be completed in 14 days (The Garden of Oz, 2009). Cold composting is slower because the temperature is not a conducive or favourable environment for the microorganisms to decompose the materials. Cold composting usually takes place in forests and may take years to complete. In Australia, composting will mostly be hot composting which is more ideal for participants (The Garden of Oz, 2009).

Appendix D: Green Insulation Tips, Pros, and Cons

Material	Application Tips	Pros	Cons
Cellulose	Available as loose fill. Appropriate for small to large remodels in parts of the structure with very low to no moisture. Good for wall cavities or attic floors and ceilings. Wall cavities need small holes to spray through. Can be blown in dry, or sprayed in damp to prevent gaps and settling.	* Requires up to 30 times less energy to make than fibreglass and mineral wool * At least 75% post-consumer recycled content (newspaper) * No effect on indoor air quality (treated with nontoxic borate)	* Can absorb moisture * Can settle (if blown in dry)
Cotton	Available as batt and loose fill. Appropriate for small to large remodels in areas with very low to no moisture. Good for wall cavities or attic floors and ceilings. Batts require open walls.	* Renewable, plant-based material * At least 70% post-industrial recycled content (e.g., denim) * Recyclable * No effect on indoor air quality (treated with nontoxic boron)	* Cotton farming typically uses large volumes of water and pesticides * Can absorb moisture
Fibreglass	Available as board, batt, and loose fill. Appropriate for small to large remodels in areas with very low to no moisture. Good for wall cavities or attic floors and ceilings. Batts and boards require open walls. Boards can be used in interior basement spaces.	* Made of abundant material (silica) * Up to 40% recycled content	* Releases eye, throat and skin irritants * Energy-intensive manufacturing process * Some products contain formaldehyde
Polyisocyanurate Foam Insulation	Foam insulation boards. Appropriate for larger projects or new construction in areas with low to no moisture. Choose closed-cell option for higher moisture areas. Best for interior basement walls, beneath siding, and attic ceilings.	* No hydrochlorofluorocarbons (HCFCs) * Typically no indoor air quality effects	* Made from petrochemicals * Not recyclable
Polystyrene–Expanded (EPS) Foam Insulation	Foam insulation boards. Appropriate for larger projects or new construction in areas with low to no moisture. Best for interior basement walls, beneath siding, and attic ceilings; can be used below grade if coated with foil or plastic.	* No HCFCs * Recyclable * Typically no indoor air quality effects	* Made from petrochemicals * Contains highly toxic HBCD brominated flame retardant and other toxins
Polystyrene–Extruded (XPS)	Foam insulation boards. Appropriate for larger projects	* More moisture resistant than EPS	* Most products still use HCFCs (but

Material	Application Tips	Pros	Cons
Foam Insulation	or new construction in areas with moderate to no moisture. Best for interior basement walls, beneath siding, attic ceilings or below grade.	* Typically no indoor air quality effects * Recyclable	they are to be phased out by 2010) * Made from petrochemicals * Contains highly toxic HBCD brominated flame retardant and other toxins
Spray Polyurethane Foam (SPF) Insulation	Spray foam is appropriate for small to large remodels in areas with moderate moisture. Good for wall cavities and attics. Sprayed through small holes in walls.	* No HCFCs * Prevents air leakage * Doesn't settle * Low density SPF bio-based products are available, which use up to 33% soy oil	* Not recyclable * Most SPF products are made primarily from petrochemicals
Mineral Wool (AKA Rock Wool or Slag Wool)	Available as batt, loose fill, and board. Appropriate for small to large remodels in areas with moderate to no moisture. Good for wall cavities and attics. Batts and boards require open walls. Can be used below grade if made for that purpose.	* No additional flame retardants necessary * Abundant materials (steel slag or natural rock) * Moisture resistant * Often contains 75%–90% recycled content	* Releases some eye, throat and skin irritants

Table 2: Green Insulation Applications Tips, Pros and Cons (Green Home Guide Staff, 2009)

Appendix E: Summarised Interviews

Jaime de Loma-Osorio Ricon
Project Liaison
18 January 2011

1. **Can you tell us a bit about the diversity of the children/community here? What types of programs do they (children and adults separate) like to participate in the centre? What are their backgrounds?**
    - *Programs divided into 3 or 4 groups.*
    - *Youth programs*
        - *Banksia study group*
            - *3 days a week from 4-6*
            - *2 groups*
                - *Primary and secondary students*
        - *Computer club- informal class can do work/play games.*
        - *Sport- rugby and soccer, possible dancing and hockey.*
        - *Similar to after school program*
            - *Kids come from migrant background so parents sometimes may find it difficult to help kids with their homework so kids come here*
            - *Kids can also come here to meet new kids if they are not from here.*
        - *Prism 10- same sex attractive young people 14-24 years old.*
            - *For people unsure about their sexuality*
        - *Youth action group- get group of young people to meet approximately every month to develop new programs or fix programs in particular area*
            - *E.g. Community is not pleased with transportation so group will write letter to get new bus line*
            - *Meetings open to anyone*
    - *Human rights education- goes around to other places in the area and deliver human rights seminars.*
        - *Run competition → participants can send drawings, videos, songs, presentations, writings, and much more about human rights:*
            - *All submissions are put in a publication*
        - *Go to schools and work with student government to empower young people and make schools more tolerant*
    - *Environmental education*
        - *Resource Smart Aussie Vic: environmental education program for schools trying to become accredited in environmental education*
            - *Under this program school teach core modules*
            - *When they complete 2 of 4 modules they get 1 star and so on up to four stars*
        - *Intro sustainability course*
        - *Radio program*
        - *Community garden*
    - *Help people who are unemployed to find job or get welfare money*
    - *Play groups, improve public well being in housing development behind Banksia: focus on crime how the community looks, problems the community may have, organise community events, give residents of bad community tools to take care of themselves*

2. **Can you tell us why the Community Centre chose to build a sustainable classroom?**
    - *Jaime interested in environmental education and sustainability*
    - *Banksia believe in social justice and environmental sustainability go hand in hand*

- *To achieve social justice, especially in the Broadmeadows community, Banksia must also work to achieve environmental sustainability*

3. **During the renovations of the current building what got changed? Why?**
   →What features in the renovated CC are sustainable?
   - *Environmental work: stage 1*
     - *Insulate hall with polystyrene foam*
       - *Changed main office from two offices to one office with a lot of natural light and got a lot more ventilation*
     - *Community garden and water tanks (2) and installing a new one*
     - *Interested in modular carpeting → carpeting was replaced with cheap unrecyclable carpeting*
     - *Kind of off topic: new toilet being built only uses half a litre of water per flush, uses compressed air Jaime wonders how much that would be*

4. **You mentioned that there are features in the CC that either didn't get changed, or got changed but not to a green materials (such as the carpet) can you name other non-green changes and tell us why they are not sustainable and what you would change them to if you could. Also there were materials that you said are environmentally friendly (such as the concrete walls) can you names some of these materials?**
   - *Carpet: would like*
     - *Natural fibres*
     - *Low VOCs*
     - *Modular*
   - *Paint: used*
     - *Low VOCs*
   - *Toilets:*
     - *Toilets are now dual flush but containers are still big and could be smaller*
     - *Would have had the rain water used for toilet water but piping was to expensive*
   - *Sinks: would like*
     - *Low flow taps*
   - *Shower: Installed*
     - *Water efficient shower head*
   - *Kitchen: Renovated*
     - *Make it look nice and replaced appliances like fridge that were more energy efficient*
   - *Boiler: replaced*
     - *With more efficient one*
   - *Fans: fixed*
     - *Were rotating wrong way, supposed to rotate counter clock wise in summer to push air down and clockwise in winter to pull air up and circulate around room*
   - *Lighting: Replaced*
     - *All the lighting replaced with new sustainable fluorescent light bulbs, most incandescent were replaced with compact fluorescent*

5. **Did you help decide on what sustainable aspects/materials were put into the new classroom? If you did, why did you choose the ones that you did? What did you learn about sustainable construction materials?**
   - *Passive design → see questions for architect, he explains this further*
   - *See drawings Jaime gave us*

- *Whichever ones would get passed by housing board*

6. **Tell us more about the Sustainability Fund that is funding the Eco-Warrior projects. What features are they looking to get out of this Building Demonstration Program?**
   →Is there anything that we have to do for the grant?
   - *Some of the materials produced have to have logo or a brief sentence about funding body*
     - *Put that on the front poster*

7. **What aspects/materials would you like to see in the interactive displays around the building?**
   →Some of our ideas include posters and pamphlets that make up a tour of the building, a scavenger hunt (using these posters), daily trivia questions for the LCD screens, a commercial put on the LCD screens, a recycling centre/ composting area (teaching them how it works/ what is important to recycle)
   → We are looking into three different interest groups, informed and interested, interested but uninformed, and both uninterested and uninformed. We have told you about our ideas, and we believe that the posters will pertain to the interested and informed, the scavenger hunt will pertain to both group 2 and 3
   - *See Jaime's handwritten notes → comments from presentation*
   - *Develop panel that links sustainability and social justice*
   - *Hands on, seeing, touching*
     - *Possible display with different glazes and a blow dryer and take temp behind window of something after blow dryers have been blowing for a few minutes*

8. **What sustainable practises do you think that the community is more apt to learn and use in their everyday routine (considering their current status being more concerned with their financial standing and other issues)?**
   - *Tour the building and walk away with shower head*
   - *Make Banksia a recycling centre for batteries, cell phones, etc*

9. **Did the architect(s) who we're meeting tomorrow work on the renovations to the current CC?**
   - *Only worked on new building*

Gina Dougall
Banksia Manager
18 January 2011

1. **Can you tell us a bit about the diversity of the children/community here? What types of programs do they (children and adults separate) like to participate in the centre? What are their backgrounds?**
   - *About 50,000 people use the centre each year and the centre wide range of programs is broad. These programs include hobby and leisure programs as well as educational programs.*
   - *There are a lot of children services based programs. You can get a diploma in children services here for people who are working in childcare.*
   - *CALD: Culturally And Linguistically Diverse*
   - *Women CALD are usually refugees and mothers that have either dropped out of school at an early age or are completely changing their job. There are about 100 women who go through the program each year and they tend to come from these backgrounds.*
   - *If one member of the family attends the centre usually they get others to join to, like a ripple effect, and multiple family members use the centre for different reasons. For example if a mom came here for the childcare services program she could hear about the holiday programs or homework help workshops and bring her children.*
   - *100 children come to the playgroup each year and they tell the parents about the other services the centre has to offer.*
   - *Most refugees now are from Middle East, Turkey, Iran, Iraq, Butane (Butanes): the centre works with them until they get well situated. They usually have waves of refugees that come into the country.*
   - *Nick works with the house complexes next to Banksias: the unemployment rate here is very high. Also the crime and safety is high along with obesity. Also people of 3rd, 4th or 5th generation Australian in a cycle of poverty*

2. **Who does Peter Lazarus tutor?**
   - *He teaches Introduction to Environmental Sustainability. The people he teaches would fall under our category of people that are interested and informed.*

3. **Can you tell us why the community centre chose to build a sustainable classroom?**
   - *Because of the supply and demand curve. The classrooms turn over huge numbers of students so seemed ridiculous that didn't have a purpose filled classroom. Wanted something that would last us for the next 20 years.*
   - *Wanted to put sustainable features in existing centre and putting garden in etc*
   - *When got grant got excited and talked to architects to see what they could do. They did a feasibility plan, which was about 1.5 million for all of this.*
   - *Vision if we had to do more environmental education needed new classroom. And wanted to reclaim more land*
   - *Everyone who came in said the centre needed more classrooms.*
   - *Killing two birds with one stone. Having more space and teaching*

4. **Can you tell us more about the sustainably fund that is funding the eco-warrior projects. What features are they looking to get out of this building demonstration program? Anything that we have to do for the grant?**
   - *Jaime knows. Project manager for eco-warrior project (interview) ask Jaime for name: oversees all Eco-Warrior project over area (6 places)*

5. **What aspects/ materials would you like to see in the interactive displays around the building?**

→ Some of our ideas include posters and pamphlets that make up a tour of the building, a scavenger hunt (using these posters), daily trivia questions for the LCD screens, a commercial put on the LCD screens, a recycling centre/ composting area (teaching them how it works/ what is important to recycle)
→We are looking into three different interest groups, informed and interested, interested but uninformed, and both uninterested and uninformed. We have told you about our ideas, and we believe that the posters will pertain to the interested and informed, the scavenger hunt will pertain to both group 2 and 3

- *Self guided tour*
- *Feel/touch the displays*
- *Permanent displays/things: fix onto the building*
- *Don't need poster or pamphlet of each display but can use to reiterate info.*
- *Handouts are good for this particular thing because it can go to their homes.*
- *Numbered, have map or something so they can find it*
- *Incorporate the classroom*
- *Talk to Hao the architect, about where to put what etc. sustainability stuff: he will have good ideas for it and stuff to say*
- *No particular date for putting the televisions in*
- *Put in recycling system! Jaime would be happy*

6. **What sustainable practises do you think that the community is more apt to learn and use in their everyday routine (Considering their current status being more concerned with their financial standing and other issues)?**
    - *No nothing particular. I think you should be guided by the conversations that you have with everyone and need to cover at least what are the main things in our paper. Wouldn't want to see a hole in anything.*
    - *It's a demonstration. Everything they won't be able to implement. They can't change their carpet or home most don't own homes or are poor. But they can reduce water bills by changing the showerhead; things can improve the quality of their life and save them money. Also about informing them even though not directly impact their lives, everyone has the right to know.*
    - *Talk about solar stuff but don't want to advertise to put them on their own roofs etc. Have to be mindful of the community we are in and not advertising anything.*
    - *Overall no, people can't afford these changes. Small percentage that can. Guided by other people.*
    - *Research more onto simple and affordable practises as well as informing them about the other stuff but need a practical response. Don't want to seem like we are preaching to people to what they need in their homes. Need right tone. Feel like it's fun and creative and people be engaged as they come in.*

7. **Is there anything else that you think is important for us to know**
    - *No as things come up we can have those conversations. We need to come and fill it all in for us they have visions in their heads.*
    - *TV screens won't just happen unless we develop the design for them where they go why we need them. Part of a planned approach.*
    - *Even if we think it is a crazy idea throw it in and we can talk about it.*
    - *Childcare has been an excellent model to motivate them and get them in the classroom what they want to do with environment stuff*
    - **Certificate 3 is lowest (teaching certificate from the centre)… for people who dropped out of school and don't know the language well, would be easy for us*

Peter Lazarus
Banksia Staff
20 January 2011

1. **What do you do with the Banksia Gardens Community Centre? (How are you involved?)**
   →You teach the Introduction to environmental sustainability course at the centre, can you tell us more about the course? For example what you teach in this course.
   - *I have taught one introductory level course in environmental sustainability. This course was 8 sessions for 2 hours each. The course looked for what things people in the community could do with sustainability in their daily lives.*

2. **What was your favourite topic to teach in environmental sustainability?**
   - *My favourite topic to teach was just trying to get people to understand climate change in its self and to get around all the scepticism about it. Also my background was in engineering so I liked teaching about what can be done around the house.*

3. **What did you do for your line or work before you retired?**
   →How did you get interested in environmental sustainability?
   - *It seemed that the government would not do anything about sustainability so I should take it up on my own to learn about it and try to get involved in doing something about sustainability. Even 20 years ago there were books about sustainability and now there are science broadcasts. I just started to read the information about sustainability and it interested me.*

4. **Tell us about some of the people that you teach?**
   →Were there a wide variety of different ages, genders, or nationalities?
   - *Well the community centre did not really advertise my class so no one really knew about it so only one person showed up to it.*

5. **Were there any strategies that you found worked the best for teaching here?**
   →What didn't work?
   →Were there certain things that worked with certain people and not others?
   - *Since there was only one person in my class I had to change around the program a bit. This guy had already known a substantial amount about sustainability.*
   - *He was very interested in different aspects of what are essentially food miles.*
     - *Where the food comes from. The packaging. How a local food supplier or restaurant could try to cut back on food miles.*
     - *It turned out that for the most part smaller businesses are just scraping by and therefore can't really afford to make changes to cut back on food miles.*

6. **What aspects of sustainability most interested the people you have taught?**
   - *Well I only taught one person and he we very interested in food miles.*

7. **Did you find that there was a large change in the people's behaviors toward being green from the start of the course to the end of the course?**
   →Was it about the same for everyone or were more impacted than others?
   - *Once again I only had one student. He was already trying to be sustainable. He had already out in tanks for water collection, which cut his water supply from 150 litres to 37 litres. But I believe the most people only have the vague idea that to save water/be more sustainable you can take shorter showers, and they don't know other things than that.*

8. **What do you think is most important for people to learn about environmental sustainability? Why?**
    - *Climate change, and water here because although we technically have a lot more water than other places we somehow have managed to use it and we keep damming off rivers to get more water however we are at the point that we can't keep doing that. Farmers don't understand why people are trying to stop their water supply.*

9. **We are trying to cater our project to three different groups of people, those who are both interested and informed, those who are interested but uninformed and those who are neither interested nor informed, where do you think the people you taught would fit in?**
   →Do you have any ideas of ways in which we can reach out to each of these groups?
    - *Practical things that they can do might be good. Try and have them bring the message home with things that they can understand like plastic bags and how there is the trash hole in the ocean.*
    - *Maybe heating their houses. → Find where the drafts are coming from and closing them up. Find where the heat is coming from in the summer so that you can close up the blinds to not use the air conditioning*

10. **Is there anything specific you would like to see in our displays?**
    - *Simple things we can do to get kids to think about it. There is this project where you take two boxes and put a light in them. One gets insulations at the top and they are both covered by aluminium foil at the top. The kids can then feel the top of them and see how the insulated one doesn't get hot at the top however the other one does.*

11. **Is there anything else that you could tell us that you think will help us with our project?**
    - *For this he gave us PowerPoint, which he used to teach his class. He went over them and we took some notes. The power points were very helpful. Informal notes have been provided below on these topics.*
    - *Sustainable homes → making your home sustainable*
    - *From book written by a guy in Canberra. (Canberra stays beautiful be cold in the winter)*
        - *Improve windows, keep shades across*
        - *People in Australia used to use tin roofs with high verandas in the east and west to shade the house. This keeps the houses cool, but since they have gotten rid of them.*
        - *Shade cloth would keep sun out in the summer but in the winter it would be rolled up to allow the winter sun to come in*
        - *Grow plants next to window on hot side because it helps keep the place cool*
        - *Curtain →Having the Curtain close to the window will keep the air from circulating into the window so that it will stay warm in the winter. In the summer pull the current out a bit so that it can hit the glass and cool down*
            - *Different currents can block rays from coming in so it is good to keep the room cool (different blinds should be external because if it is internal then it will not keep heat out because it is already inside the house*

Georgina Murphy
Environmental Education Officer, Hume City Council
20 January 2011

1. **What do you do with the Hume Council?**
   → We know that you lead the environmental team there, but what exactly does that put you in charge of?
   - *She is an environmental education officer*
     - *Internal program: engaging stuff mostly about individual actions that reduce environmental footprint like taking transportation to work*
       - *For staff mostly*
     - *External program: Develop a community program (children) educating community: "Live Green" will launch in march*
     - *Environmental workshops*
       - *Green Diapers*
       - *How to install recycling systems*
       - *Leadership series: they identified people who are leaders and ask to train them and then have them identify projects they want to work on*
         - *Give community skills to deliver environmental projects (e.g. create vegetable garden)*
   - *Internal program*
     - *Community involvement*
     - *Changed behaviour*
     - *Live green work green (name of program)*
     - *Pathways to sustainability Framework*
       - *5 key approaches to demonstrate leadership to community*
       - *2009 council adopted*
       - *2010 in-house actions*
         - *Did in house before promoting to community so show they are ahead of the game and to follow them*
     - *5 approaches*
       - *Planning*
         - *Getting EMT involved*
           - *CEO and under CEO have 5 directors and head: finance, sustainability etc*
           - *Executive Management Team (EMT)*
         - *Staff survey 3 months prior to launch*
           - *Where thought they were at in terms of environmental sustainability*
           - *Where thought council was*
           - *Where thought council should be*
           - *Learned from the staff that they wanted to know what actions they could do in workplace (from survey)*
         - *Greenprint session (same as blueprint session but green for name)*
           - *Wanted them to be committed to program*
           - *Key result of survey was that people thought EMT/council house didn't care about environment*
           - *Asked each EMT member to come up with environmental commitment*
             - *CEO take train more to city*
             - *Blew commitments up to demonstrate commitment (at launch)*

            - *Coffee cup not paper everyday for work*
            - *Print on both sides of paper*
            - *Turn off lights and computer at end of each day*
            - *Marketing icons: shorter showers*
            - *Recycling*
        - *Iconography and logo*
    - *Green teams*
        - *People who are organising to improve environment*
        - *Key influences in workplace*
- *Launch*
    - *Blew up commitments at launch*
    - *Green is up and coming now*
    - *Well know people as well as employees*
        - *Photo shoot that they played with the icons*
            - *If see people you know in pictures more involved/engaged*
    - *Advertising*
        - *Organic apples and put stickers on it saying see you at the launch (13,000 employees) (hand delivered)*
    - *Launch across 4 sites*
        - *Depot: where blue collared workers work*
            - *Presented differently: tailored to them*
            - *Driving efficiently etc*
    - *Interviewed people before asking why interested in helping the environment*
        - *Future generations*
        - *Concern for kids*
        - *Making more human strikes emotional calling*
        - *Don't be dictatorial*
        - *People needs to change within themselves the need to want to make the changes*
            - *Educate and empower*
    - *Getting people excited*
    - *Getting out initiatives*
    - *Zone 2 is more expensive so catching it is more expensive*
        - *Cheaper pass arriving before 7am*
    - *Looking to push government to make Broadmeadows Zone 1 place*
        - *But underprivileged and poor*
    - *Green Breakfast*
        - *Created a popup café: quarantined place in parking lot and made BBQ and all that and took over car park and people who drove missed out on breakfast*
        - *Wear stickers of how get to work*
            - *Conversation starters*
    - *Green travel Friday*
        - *Every last Friday of the month*
        - *Have poll so they can measure change of month*
    - *Say who live in zip codes to say who will want to carpool with*
        - *Carpool database*
    - *Energy conservation signage*
        - *What language would banksias do?*
        - *Keeping branding really consistent*

        - *Making sure that things fit with the people there*
    - *Computer shutdown audits*
    - *4 bin infrastructure and signage at depots*
- *Maintain momentum*
    - *Stage they are at the moment*
    - *Challenging phase because people excited at first then loose excitement*
    - *Work with human resources department because they organise how council operates work with them to make green travel booklet:*
        - *Gave us one*
        - *Green travel booklet: shows how can get to work and sit down with officer who can tell you best way to get to work*
            - *Hr distributed: more mainstream that way better than from green team people*
    - *Recognition!: won award for work done in building*
- *Measurement*
    - *Measure energy water and waste*
        - *5 key sites based on number of employees and if easy to get data*
        - *Measure usage*
    - *Communicate what find with people*
    - *Measure green procurement*
        - *Corporate stationary: how much is green or environmentally sustainable/recycled*
    - *Annual council survey: measure who travels sustainably*
    - *Do initial survey a year after the launch*
    - *Banksias: do survey to find what we have changed*
        - *Face to face survey (translators)*
        - *C.A.L.T*
        - *A lot of people think it is a test so need to break that barrier*
        - *No wrong answers*
            - *Evaluation survey*
        - *Centre staff aware of program*
        - *Changed behaviour*
- *Her background in media and communications*
    - *Focus in changed behaviors*

2. Can you tell us about the educational programs that you design?

→ What do you teach people about during them?
→What do you do during these programs?
→Is it more hands on or is it more of a lecture?
→What age groups do you target?
→Who most often attends these programs?

- *See Question 1's Answer*

3. What aspects of sustainability do you believe most interests the people who have come to your educational programs? Why?

- *What most interested people:*
    - *Less about the environmental focuses more about building a change*

        - *People wanted to be part of this change and people were ready for the change*
        - *Like being a part of the community*
    - *Photography*
    - *Clarity of the campaign: small changes, big difference.*
    - *Reporting back each month so people can see the change*
    - *Making it fun!!*
    - *Tie things into saving money*
        - *Veggie garden saving them money*
        - *Turkish women catching rain*
        - *People making their own clothes*
    - *Making it feel like a program that is going to last (they tried that last time and it didn't work)*

4. **In your experience what have you found to be the most successful strategies/ ways to teach people about sustainability that helps them understand the concepts?**
    - *Make them excited about it! (see previous question's answer)*
    - *In summary things that worked*
        - *Making it fun*
        - *Speaking face to face*
        - *Keeping things to a minimum in terms of words*
        - *Getting leaders to demonstrate: Green Team*
            - *People leading by action*

5. **We are working with the BGCC looking into their renovations and the new classroom that they are building and we are trying to find ways to teach the community about this project through interactive displays and activities. Our target consists of three different groups of people. These groups consist of people who are informed and interested in sustainability, people who are interested but uninformed and people who are neither interested nor informed in sustainability. Do you have any good strategies or ideas about displays that we should do for our project?**
    - *Objectives*
        - *Do you want to change the behaviors*
    - *Douglas Mackenzie moor*
        - *Believes pamphlets won't work unless with something else*
    - *Ideas*
        - *Tour will work well (guided tour might work better)*
        - *Images ideas*
        - *Commitments*
            - *Jaime makes commitment (pictures)*
            - *Distinct leaders of groups*
                - *Turkish groups/Bhutan*
                - *Pictures of them doing environmental actions*
        - *Energy and water bills that we can assess for them*
            - *Face to face contact works well*
        - *After get ball rolling make a workshop*
            - *Discuss and have an open forum*
                - *Story telling works well*
                - *Used Tupperware instead of plastic bags*
                - *Power of word of mouth and sharing environmental stories will be more powerful than us and more subliminal*

        - *How grow own veggies*
        - *Get your hands dirty and interactive will learn more*
        - *Making more discussion based*
        - *Incentives for people to come*
        - *Teacher meet every quarter to see what other people are doing (get ideas)*
        - *Guest speakers (inspirational)*
        - *Keep it simple for the time period that you have*
        - *Make up signs saying things that are tangible*
            - *Equivalent from driving from Melbourne to Perth 5 times = like some number kilojoules but the numbers they won't take in*
    - *Take signs*
    - *Mini shower timers*
    - *Give Aways (if give away and not tell them pointless)*
    - *Tap into community feel*
    - *Where face to face simple communication*
        - *Workshops and guides*
    - *POWER OF MOUTH*
    - *Create a list of activities/program and create a list of how sustainability can fit into the programs*

6. **Do you have any other ideas or information that you believe will help us successfully raise awareness and educate the community of Broadmeadows?**
    - *Slow process, won't happen overnight*
    - *Relating it back to money!*
    - *Short and sharp name! Simple*
    - *Make an icon/name that people are aware of and if see they are like oh ya that sustainability thing*
        - *Iconography*
    - *Have a launch, have Jaime speak, showcase DVD etc*
        - *Future idea to success for banksias!*
    - *Mx (newspaper on the train) has tidbits of trivia info*
    - *Get DVD and get people who are involved and get them to go on a tour and they can point out things that are sustainable and they can do funny things and get community groups involved*
        - *Immunisation sessions recycles*
        - *Might not be able to do because of building not done*

Megan Bond
Eco-Warrior
21 January 2011

1. **How long have you been working with the Eco-Warriors?**
   →What made you decided to work with the Eco-Warriors?
   - *Experience with the Eco-Warriors, and decision to participate/volunteer*
     - *First meeting with Jamie in July*
     - *Finished work and going for PhD*
     - *Wanted to do something that had practical application to the theory she has been study*

2. **What did you do before joining the Eco-Warriors?**
   →How did you get interested in environmental sustainability?
   - Worked for the Government before – climate change and adaptability

3. **What do you do with the Eco-Warriors?**
   →Do you only teach people about environmental sustainability?
   →What age group do you usually target?
   →In your experience are there different aspects of sustainability that interests certain age groups more than others?
   - *University kids, school holiday programs, Vic Aussie Resource smart training (need training program to go into schools)*
   - *Working to get the whole school involved and work through various modules, it's a government accredited process (through Banksia)*

4. **What aspects of sustainability do the Eco-Warriors work with most?**
   →What aspects interest you the most?
   - Climate change

5. **From your experience working with the Banksia Gardens Community Centre what programs most interest the community?**
   - Only been working with them for a short time so unsure

6. **What activities have you found to be the best to educate people about sustainability? (IE games, little projects, science ideas)**
   - *Activities that best educate people*
     - *Used to be a teacher*
     - *Taught all age levels from 1-senior high school, tutor and lectured @ university level*
       - *Need to be excited about subject – and then people will "come along for the ride"*

7. **What aspects of sustainability do you think are most important to teach? (IE, climate change, biodiversity, pollutants, waste, etc.)**
   → What do you think is most important to teach the Banksia Gardens Community Centre?
   - *Most important sustainable elements – relate to Banksias*
     - *Hard, PhD research*
       - *Various communities have different*
         - *Ex. Fruit and vegetables, creating more advanced landscapes (orchids), waste reduction*
     - *Moreland*

    - *Create wonder and appreciation for natural world*
        - *So it becomes something we fundamentally value*

8. **What sustainable practises do you think are most important to introduce in general/ to the BGCC?**
   →What do you think they will most likely take home and use in their everyday life? (IE recycling, composting, turning off lights, shorter showers)
   - Not working with them long so unsure

9. **We are trying to cater our project to three different groups of people, those who are both interested and informed, those who are interested but uninformed and those who are neither interested nor informed; do you have any ideas of ways in which we can capture the interest of each group with our displays/activities/tours?**
   - *Talk about peoples local and actual experiences*
       - *If we globalise it, doesn't mean much*
       - *Contextualise it with what people understand and deal with in a day to day basis*
       - *Start on peoples knowledge base (shoot too low- insulting, shoot too high- won't understand)*

10. **Do you have any other information or ideas that you think would be help us to make our project successful?**
    - *Be adaptable*

Hao Lee
Architect
26 January 2011

1. **What has been your experience with using sustainable products/design in your line of work?**
   - *Worked on the new schools in Broadmeadows that are replacing the school where Banksia's holiday programs are currently taking place*
   - *The school is almost entirely self sustainable*
   - *Does not use electricity*

2. **What aspects of sustainability did you focus on in the design/construction phase of the classroom? Examples: energy, water, etc.**
   - *Double glazed windows in classroom*
   - *Water tanks*
     - *Water tank used to collect rain runoff from roof for gardening and other recreational activities*
   - *Glazed windows*
   - *Solar panels*
   - *Air Cell insulation*
   - *Separating classroom from building itself→ rework courtyard to make area more inviting and surround classroom with greenery*
     - *Gives image that building is literally greener*
     - *Can help cool building in sustainable way*

3. **Can you tell us about all the sustainable features that you are constructing into the classroom?**
   →Follow up: What do you think are the more crucial materials that make the classroom sustainable?
   →Follow up: What were the different types you used (brand). What kilowatts of a PV panels.
   - *Solar panels will be mounted in courtyard above windows as an awning and some will be mounted on the roof facing north*
   - *Passive design: the building is oriented North to South to allow for more natural light to enter the building*
   - *The roof of the building is sloped from north to south*
     - *Windows larger in north to allow even more natural light in*
     - *Sloped roof allows for better ventilation from south to north*
   - *Floors are made of concrete and bamboo*
     - *Concrete has good thermal properties→ Captures heat and therefore will require less energy to heat classroom in winter*
     - *Bamboo is a sustainable material→See proposal for facts about why bamboo is sustainable*
   - *Metallic blinds will be placed about windows that can be lowered to keep heat out of building during summer months*

4. **Why did you pick the materials that you did? (or conclude with this compromise with Jaime) Example: Because they are the best materials for sustainability, because they are the most affordable. Are there materials that you wished you could have used, but did not?**
   - *Went with the basics listed above because of cost and limited funding*
   - *Recycled materials are more expensive*

5. **Can you tell us a bit about each material/the materials that you find most important to the building?**
   →Follow up: If you were to select the most important features/materials to teach the community about, which would you pick? Why? Do you think these materials you stated are the best for this building?
   - *Told us he would send us a list of all of them*

6. **Jaime told us a bit about the placing of the windows in the building. Can you tell us exactly how you orient the windows and the building to maximise lighting? For example Jaime was saying how there are larger windows on the east side than the west side of the building.**
   - *Answered with Question 3.*

OTHER QUESTIONS

7. **Do you have a set of current blue prints?**
   - *Yes and agreed to send them to us.*

8. **What are some easy and affordable sustainable practises that you believe will go hand in hand with the sustainable materials that were put into the building (such as recycling and composting)? Why?**
   - *Did not have thoughts on this*

9. **Asked him if we could be in contact with him regularly if we have questions.**
   - *Exchanged email information and he said he would be back in two weeks if we wanted to meet with him.*

Andrew Lewis, Pennie Stoyles
Scienceworks
01 February 2011

1. **When was Scienceworks created? What has been changed from the beginning?**
   - *Scienceworks was started about 20 years ago.*
   - *The building is not sustainable because it is an old building and it would have just cost too much to make it sustainable however they would like it if it were.*
   - *When science works first opened engineers made each display. They were great displays however they were all broken within the first day or two. This is because the displays were not made in a way that kids could play with them and tug on them. The displays were not robust.*

2. **We are working with the BGCC looking into their renovations and the new classroom that they are building and we are trying to find ways to teach the community about this project through interactive displays and activities. Our targets are three different groups of people. These groups consist of people who are informed and interested in sustainability, people who are interested but uninformed and people who are neither interested nor informed in sustainability. Because our project is science related, and we are interested in exciting, interactive learning tools, we came to you to ask you some questions about displays in Scienceworks and good ideas.**
   - *Solar energy: see how much energy you can generate from the sun and get a digital read out. Make it so the people can feel it, and be able to put their hand so it blocks off part of the solar panel from the sun so you can see how that effects the amount of energy that you are collecting.*
   - *Wind energy, whirly gigs are great things; you can have them produce noise. (Whirly gigs can be understood because you can see the cause and effect)*
   - *Anything to do with kids touching water is great.*
   - *For recycling find some cool sculpture that can be made out of recycled goods so that people will want to recycle that certain good so that someone can make that sculpture. Knowing what can be made from recycling can cause the "Gee Whiz" factor.*
   - *The difference between the floor temperature and the ceiling temperature for the slanted roof.*
   - *Some windsock or something to show the draft from the slanted roof.*
   - *For biodiversity you can have them find a species of grass and then there will be a board with choices for it (is it green, is it tan) then the person picks the right path for their piece of grass and it brings them to another set of questions, in the end they can use the path to identify the types of grass. Also the "there are over 200 species of grass in the Banksia Community Centre" is a great "Gee Whiz" factor.*
   - *Unexpected things that can be made from bamboo, or that is being made from bamboo around the world such as a push cart.*
     - *Buildings made out of bamboo stronger than steel framed buildings*
   - *A pinball game where the balls in sustainable things worth points. The basic pinball where you shoot the ball up and it comes down through a path of nails*
   - *Some type of display that shows how it takes the same amount of energy to light up an incandescent light bulb as it does to light up five fluorescent light bulbs.*
   - *Showing how much power is still being used when something is on standby and showing how it is important to turn things off at the outlet.*
   - *Show money saving from changing light bulbs to fluorescent, or by turning off the power switches or what not.*
   - *The sustainable house game. You start out with a moneybag and you work to create your house. You have simple sustainable options like the orientation of the house.*

Throughout the creation of the house you are losing money by putting things in but the process also goes through the amount of money that you save from doing sustainable things. At the end you will see the size of the moneybag.

3. **What is the typical age range that comes into this museum? Is it mainly kids or are there adults that come in here because they are interested in learning as well?**
   - *We have a kids display for ages 6 to 8. This display is upstairs.*
   - *Other then that the display is for people of all ages.*
   - *There are many kids that come in to Scienceworks but it is engaging for people of all ages.*

4. **What are some of the popular displays that have been displayed in this museum? Do you know why they caught people's interest?**
   - *All of the displays tend to be popular.*
   - *Right now everyone that comes in seems to go right for the bed of nails display.*
   - *This display allows you to lie on a bed and the nails emerge from below it, so that they are poking in all over your body.*
   - *The display shows you that while if one nail touches you it might make you bleed however you can lie on a bed of nails due to the properties of weight over an area.*
   - *This display caught people's attention because it is very interactive and out of the ordinary everyone wants to try it out.*

5. **What do you think is important to incorporate into a display to catch people's attention?**
   - *Something that they cannot do at home. We steer away from displays that have video games in them because everyone plays video games and home or watches TV. So it is important for them to want to come to Scienceworks to do something that they cannot do at home.*
   - *Also it is important to make it so that displays have a cause and effect. Kids learn better if they can see the effect of what they do. Video games can show this.*
     - *For instance one display you have a long rope that is connected to a big weight and you can put all your weight on it but it will not lower the rope. Through a system the other side has a rope that is connected to the same weight however when you put it, it will lower. This is a simple system that can show a kid the scientific property that will allow something to happen.*
   - *Lastly the display needs to have a "Gee Whiz". If you look at something or read something and say "Gee Whiz" then you will remember it and you will stay interested in it.*
   - *Also anything that has colour, is simple, maybe something that you can touch or feel, or has different temperatures.*
   - *Be clever about what you do. Make it something that is not the same. The display can be common sense but it NEEDS to be interesting*
   - *If a subject matter is not interesting then it is a challenge, you have to make it interesting.*
     - *For example the sewage lines/ states the runs through all of Melbourne and ends in Werribee would not be an interesting display but making a computer programs where you can flush a toilet from anywhere in Melbourne and then you can see it go through the pipes all the way to Werribee would make it more interesting. To actually be able to go down and see the sewage lines and pump and be able to explore down there, and crawl around in the spidery area would make a great display.*

6. **What are some of the less popular displays? Do you know why they did not interest people?**
    - *A display that does not have a GEE WIZ effect. (They did not describe a display)*

7. **What is your process of selected the types of displays and activities to showcase in the museum?**
    - *They have to bring them too the board. They did not elaborate on the process.*

8. **Is there any other information you feel can help us with developing our displays and activities? Maybe some display ideas, or just some good information's on how to make affordable, interactive displays.**
    - *When we write a new program decided on a message, a key message and some side messages that you are trying to get across to the public through the display. Make sure that whatever you make stays on the track of your message.*
    - *Have a "Gee Whiz" or a "Wow" factor for everything that you create so that they will remember it.*
    - *When looking for materials try talking to large companies and get them to donate it. Tell them about Banksia, that it is a poor community and tell them that whatever gets donated will have some type of thing that states who donated it; however it will not be a marketing ploy. It will explain the science behind it. It will state, "This is a clever idea because ___ and here is the science behind it" but it will not talk about the company and who makes it and where to buy it and all that.*
    - *Video games will always beat the computer activities so make the computer activities simple. You do not need fabulous graphics.*

9. **If we have any other questions may we contact you in the future? Also we are writing a research paper about this project. May we quote you or use your name in the paper?**
    - *Yes*

Nick MacHale
Community Connections Manager
03 February 2011

1. **Can you tell your role in Broadmeadows housing?**
    - *The project manager for community development in the low-income housing development by Banksia*
        - *The housing development are 3 bedroom units, that are cheap and poorly built; they require low maintenance*
        - *No one pays for water, therefore they don't care about wasting water, this may pose a challenge to your project*
        - *Tenants have to pay for electricity, this can be a good target for your project*
    - *Advocate services to participate in improving community*
    - *Worked at Banksia Gardens for a year, at the Broadmeadows housing development for 3 years*

2. **What are the demographics of the Broadmeadows community? What different ethnicities are involved in the community?**
    - *143 housing units*
    - *53% of the people living in the estate are under 25 years old*
    - *Only 10-15 people are over 50 years old*
    - *49% of the people are foreign (Africa, Middle East, Eastern European, South American), the speak English as a second language*
    - *5% of Broadmeadows is indigenous people whereas the amount of indigenous people in the city of Hume is 0.3%*
    - *10% Pacific Islanders*
    - *People have a low level education, 25% complete secondary school whereas 50% of Melbournians complete secondary school*
    - *70% of the housing estate are occupied single mothers*
    - *25% of the people are unemployed*

3. **What are the typical types of people who live in the community? Is it mainly families or is it a lot of young adults, middle-aged adults, or senior citizens?**
    - *Estates house families usually of single mothers*
    - *The people living here are very dependent on government housing*
        -
    - *There are many barriers including language, transportation, race, gender, etc*
        - *Banksia have organised many services (programs) to alleviate these barriers through passiveness, neutrality, openness and acceptance*
        - *They have been very successful*
    - *Though the estate may not look very harmful, there are actually acts of violence that happens*
    - *Refer to Question 2*

4. **How does the Broadmeadows housing work? Is it low income housing?**
    - *Key factor to this housing development is low income families*
    - *There are many housing developments in Victoria, there is even a shortage of housing but there are spaces in the Broadmeadows one due to the security of the area.*
        - *Security issues include physical health, substance abuse, and domestic violence*

- *For housing, it requires a 7-8 year wait for early approval. If not given early approval housing, people are put on a housing waiting list; but it is not likely they will get any housing.*
- *The criteria to apply for housing: if the individual is homeless it is very easy for him/her to get housing, there is a policy that states that a mother with children cannot be homeless for more than 3 days*
- *Usually the rent is $700 AUD per month, but no one will pay for more than 25% of their income*
- *Homeless and jobless people with housing at the Broadmeadows housing are on a temporary welfare system*

5. **What is the average level of English spoken in this community? Can most people speak fluent English? What reading level do you think they have?**
    - *Generalisation, know enough English to get by, even for 6th 7th gen Australian*
    - *Financial literacy is a huge issue too*

6. **We know the unemployment rate in the Broadmeadows housing is very high, but can you tell us more about it?**
    - *The poverty level isn't blatantly noticeable*
    - *You will notice if you get to know the people*
    - *There is a high crime rate and drug abuse*
    - *The people are very poor at budgeting their money, a lot of them do not know how to cook food, therefore they buy fast food like McDonalds*
        - *It's alright if you're just buying a meal, but the money adds up if you have to feed a family for every meal*

7. **What interests the community? Is there any specific activities, sports, programs, or events that they are interested in?**
    - *The children are involved in study groups and sports including Australian rule football, basketball (indigenous and Polynesian population), rugby and football*
    - *He doesn't see the older people as much*

8. **Do you know the communities interest level on sustainability? Or if they have any interest in the topic at all?**
    - *No, they are not interested. They don't have a connection with the topic, they don't see how sustainability relates to themselves*
    - *They also have too many other concerns to worry about*
    - *Economic participation, the community looks are their budget and cannot afford any of these sustainable features*
    - *They aren't empowered to be active*

9. **Are there any people in the community that has tried to put any sustainable features in their house? If so, what? (solar panels, water tanks, hot water heaters, E-film on the windows?)**
    - *No tenants have put these features in, because it s a government owned estate, but also because they cannot afford them.*
    - *The government did not support the proposal to install solar panels in these houses*

10. **As you know we are working with the BGCC looking into their renovations and the new classroom that they are building and we are trying to find ways to teach the community about this project through interactive displays and activities. Do you have any good strategies or ideas about displays that we can consider for our project? Or anything that you think might interest the community?**

- *Free stuff (e.g. light bulbs, draft stoppers for the winter) or food incentive*
- *Teach in a way that they learn how to save money*
- *Have a hook for people*
- *It is more challenging to engage parents, they have a resistance*
- *Many people see being environmentally sustainable is a middle class white thing to do*
- *Perhaps put an exhibition on the estate*
- *Make displays that are tactile, for the people who are uncomfortable with academia, this is less intimidating*
- *Be careful about being bias, make it more real for them*
- *Get children to be involved in a practical and scientific*
- *If it is difficult for typical Australians to be sustainable, it is even more difficult for the foreign Broadmeadows community*

11. Do you have any other information that you think would help us complete our project?

- *The more children we get involved, bring more parents in*

12. If we have any other questions may we contact you in the future? Also we are writing a research paper about this project. My we quote you or use your name in the paper?

- *Yes, that's fine*

Appendix F: Observational Journals

Journal Entry #1

14 January 2011

Hume Central Secondary College

Eco-Warriors Session – Climate Change

Today we attended the first Eco-Warrior session of Banksia's four-week Holiday Program. There were about 25-30 students in attendance, about fifteen between the age of eleven and sixteen and about ten who were between the ages five to ten. A majority of these students were of different nationalities and also had good relations with Jaime and the volunteers who supervised them.

We arrived at the school at 9:30am, a little before the morning session of the Eco-Warrior program. When the volunteers started to gather the older group for the Eco-Warrior session, many of them started to retort and object, seeming uninterested in the day's session. As the session started, many of the students were restless and did not stay in their seats. The Eco-Warrior instructors had a hard time settling them down and starting the session. When the students were asked the question "What is climate change?" many of the youth replied with "I don't know" without hesitating. A lot of the students exclaimed that this session felt as if they were at school sitting through a lecture, rather than on summer holiday. We participated in the two activities of the day, brainstorming the definition of climate change and a United Nation style debate of how climate change affected various countries. Many of the students did not participate in the activities, they started conversing with each other, playing music on their phones and getting out of their seats and chatting with friends who were sitting at different tables. As the end of the activity drew near, many of the students relied on Trevor, Sasha, Alison and Nica to complete the assignment. However, the students Alison worked with applied themselves with a little explanation, encouragement and persistence. After the Eco-Warrior session concluded, everyone congregated in the staff room to have lunch. Many of the students were chatty and enjoyed each other's company. It was a very light atmosphere and the students

were very relaxed. For the afternoon session, we observed the older group while they were swimming. Mainly the boys were in the water, tossing around and playing volleyball with rubber dodge balls. Overall, the students were very energetic. Before we left, we briefly observed the afternoon Eco-Warrior session with the younger students. They were very engaged in the sorting recycling activity and many of them raised their hands enthusiastically when asked a question. From today's observations and interactions, we concluded that our displays and activities must immerse the youth's whole body so they can "see" with their body.

Journal Entry #2

17 January 2011

Hume Central Secondary College

Basketball Session

Today we attended the basketball session of the holiday program. There were about 30 students who attended this session. A couple members from the Melbourne Tigers basketball team made an appearance to teach the youth the basics of basketball. Before they arrived, a Melbourne Tigers instructor organised little activities and games for the students including dribbling drills and various versions of knock out. Youth from all age groups participated in this event, which posed a problem since their various abilities and skills made it difficult to make the games fair.

During the dribbling and shooting races, many of the students were very engaged in the competitive activity. However, when the instructor was explaining the rule to the various games, many of the students were distracted by bouncing their basketballs and did not listen. As we were playing the games, many of the students were not aware of the rules and often got frustrated when one of the aids dismissed them from the game. Many of the older students did not empathise with the younger students, and the younger students therefore felt a little frustrated with the activity.

When the assistant coach and a player from the Melbourne Tigers arrived at the gym, they had a difficult time rounding up all the students because they were shooting around in the gym. Even after the holiday program volunteers rounded everyone up, the students were distracted with bouncing their balls for a while. The coach redid some of the dribbling and shooting drills and the students were just as enthusiastic about that than the drills they did earlier. At the end of the session, many of them asked the two idols for autographs.

Journal Entry #3

21 January 2011

Hume Central Secondary College

Eco-Warriors Session – Biodiversity

Today we attended the second Eco-Warriors session about biodiversity. Again, we arrived at Hume Central at 9:30am to attend the 10:00am morning session with the older group. About twelve students attended this session. The instructors were prepared with activities that required the students to pay attention to the proceedings in order to understand the course of the activity. The main activity had the students divided into two groups and required them to follow instructions to fold origami animals and trees. Using the origami, the students were asked to develop a poster that portrays biodiversity. We observed that the students were more interested to participate in this activity, as opposed to last week's United Nations activity. Inadvertently the posters became a competition, therefore the students were challenged and motivated to create better animals and a better poster. Through this activity, we noticed that the students had more positive energy and they enjoyed folding the origami. They also were not hesitant with asking our group questions, showing that they were comfortable with us. The hands-on activity occupied the students all the way to the end of the session. Everyone was keen on decorating the posters. At the end of the session, some students were excited and proud to present their poster. Some of the students listened and kept eye contact with the presenter, while she was explaining the poster. However, there were students who were engaged in folding the origami, but became disinterested during the presentations.

Journal Entry #4

27 January 2011

Broadmeadows Neighbourhood

Peter Lazarus' Tour

Today we attended a tour of a neighbourhood in Broadmeadows, hosted by Peter Lazarus. Lazarus is the instructor for the Introduction to Sustainability class held at Banksia Gardens Community Centre, and a tutor for the after school program. He has a strong personal interest in environmental sustainability and has made sustainable additions to his home. Lazarus picked us up at the community centre at 10:00am. He drove us around a neighbourhood by his house to show us different houses under construction. On our way to the neighbourhood, he pointed out the bike paths, which run all through Broadmeadows, and all the way into the city. He explained that we can receive more information about the bike paths on the government website. When we arrived in the neighbourhood, he pointed out different houses that had solar panels or hot water heaters on their roofs. One point that he stressed was how only a few houses in the area had these features. He also noted that the only reason why some of the governmental housing estates had solar panels were to receive accreditation, not for the energy efficiency since each home was only connected to one solar panel. He also stressed how some of the houses were poorly designed. Many of them had big windows that were not shaded from direct sunlight thus they would get really warm due to the poor insulation. Other houses were not oriented in a way to maximise their natural light intake. We have noticed very few residents who utilised window blinds to keep their houses cool during the day.

We stopped at a construction site of a house. Lazarus led us into the house and pointed the deferent features in a standard house in Broadmeadows. Standard houses are built out of conventional timber and shelled with a layer of brick. He exclaimed that there were very few windows and that they were single glazed and not double-glazed. Double-glazed windows, he said, are not a standard feature in Australian houses. The house had a single layer of metallic

insulation on each wall. Lazarus stated that standard homes usually only incorporate a single layer of metallic insulation if any at all. The house also had insulation in the ceiling, which is said is a common theme.

We also toured Lazarus's house where he showed us the features that he added to his house to make it more sustainable. These features included seven solar panels, a hot water heater, e-film on the windows, and a 16 thousand-litre water tank. He told us that he solar panels usually produce 30% of the energy that he uses annually. The solar panels were connected back into the grid, and he explained to us how he sells the energy created from his solar panel back to the grid. He showed us his storm water collection tank, which he uses to water his garden. Then he pointed out the exterior blinds he added to each of the windows of his house that faced north. He also had several other plants around the property, in addition to the gardens, to help improve the air quality. We noticed that he had two bins for rubbish and recycling, respectively. Upon asking him, Lazarus explained that he disposes of his rubbish and recycling through a kerbside pick-up system.

Before leaving the neighbourhood, one last thing that he pointed out was that older houses were designed with large overhangs to provide the house with shade, however newer homes do not have the overhang because that feature is expensive. He explained that the overhang provide the houses with natural light without allowing direct rays to come through their windows, therefore allowing less heat transfer into the house.

Journal Entry #5

27 January 2011

Level 28 of Urban Workshop, 50 Lonsdale Street, Melbourne VIC 3000 Australia

Sustainability Victoria Tour

At 2:30pm we arrived at Sustainability Victoria, on the 28th floor of the Urban Workshop. We were introduced to Tony O'Loughlin, who took us on a tour around Sustainability Victoria. Sustainability Victoria has a five star Green Star accreditation for office buildings. This floor is home to many sustainable features including double glazed windows, energy efficient lighting, carpet tiles made from recycled materials, and a big disposal centre. The disposal centre is a large white cabinet with four openings for the four bins located inside. The four compartments consist of compost, recycling, rubbish and cardboard. O'Loughlin pointed out that the size of the rubbish bin was significantly smaller than the recycling and cardboard bins. Meaning that the employees are actively reducing their environmental footprint by reducing the amount of rubbish they dispose. This centre gave us many ideas for a recycling centre that we are hoping to build for Banksia Gardens Community Centre.

Sustainability Victoria has an open office policy, which means that the office is open and not made up of cubicles. O'Loughlin explained that the open office policy allows people to get up, walk around and mingle with co-workers, making work more enjoyable. Another feature of the social atmosphere was the kitchen, which now contains slightly outdated energy and water efficient appliances such as energy efficient kettles, toasters, water efficient dishwashers, and water efficient taps. O'Loughlin showed us the office's printing centre that was created as a central printing area so employees did not require a printer at his/her desk, in turn, saving energy. This centre requires each person to scan his/her card in order to print his/her documents, which results in significantly reducing the amount of paper that is wasted through printing. O'Loughlin showed us a stack of three sheets of paper and stated that these pages were all the wasted pages from the last few weeks. He said that because each person has to walk to the printer to get their printed documents, the amount of printed documents that are forgotten

has reduced greatly. O'Loughlin also pointed out that each desk was equipped with a laptop. Laptops are used here because they use less energy than desktops and it allows people to work from locations other than their desk, such as at home, conference areas or the kitchen.

In the lobby area were two caged walls with plants growing up them. These plants are used as a way to improve air quality and to cool the office. Sustainability Victoria also had a room created from recycled refrigerator boxes that were cut and stacked into the shape of a lima bean. The room looked like a giant beehive. It was created to score innovations points for the Green Star rating system. In addition, this piece of sustainable art helps create a sound barrier between the kitchen and the workplace and it is used as a place to mingle or have an informal meeting.

Journal Entry #6

28 January 2011

The Building Commissions Office, 710 Collins Street, Docklands VIC 3008

The Goods Shed North Tour

Before arriving at the Goods Shed North we conducted some background research on the buildings, and got a brief overview from our project advisor, Holly Ault, who accompanied us on the tour. From the information she shared, we concluded that the Goods Shed North was created on the Docklands in 1889 as a place for trains to collect and drop off cargo. In 2009, the Goods Shed North finished its renovations making it the new home to the Building Commission, as well as a five star Green Star accredited renovated heritage building.

Upon arriving at the Goods Shed North we met Dennis Hogan and Skye. Skye explained that since the Goods Shed North is a renovated heritage building restrictions were added, which stated where constructions could and could not take place in the building. Nevertheless, the building still incorporated many sustainable features. Some of these features included the old windows being replaced with double-glazed windows, the concrete floor being covered by recyclable carpet made from recycled materials, and a tri-generator used to generate most of their power. Skye explained that due to the heritage building restrictions electrical wires were not allowed to be implemented in the ceiling or walls. Thus they were stationed below the floor were a trench houses the electrical wires. The trench also doubles as a ventilation system, by circulating fresh air into the building. She also stated that there are 320 different plants out around the office, used to improve air quality and cool the air. Similarly to Sustainability Victoria, the Goods Shed North also has a printing centre, where, each worker has to scan his/her card in order to print documents. Also like Sustainability Victoria, the Goods Shed North has an open office policy, which allows workers to get up and walk around, and not feel secluded in their cubicles.

The Goods Shed North's most unique feature is their four towers, which were built for innovation point in the Green Star rating system. The first tower was made entirely of glass and

is a large, quiet room used for staff presentations. The second tower, Skye explained, is called the Tree House because it is made out of wood. There was an upper and lower level to the tower. The lower level is closed in and quite, making it a great room for important meetings. The upper level was a more general meeting area. The third tower housed a kitchen in the lower level and another meeting room in the upper level. The forth tower had the manager's desk in the lower level and, again, another meeting room in the upper level. Skye stated that the manager's office is open, just like every other desk in the office.

The Goods Shed North has a bike storage space for workers to stow their bikes while they are at work. Skye told us that the Goods Shed North also has a shower facility provided for cyclist commuters. She said that the Goods Shed North does not have a car park, which encourages employees to take public transportation, cycle, or carpool to work.

Journal Entry #7

1 February 2011

2 Booker Street Spotswood VIC 3015

Scienceworks Museum

At 1:00pm we arrived at the Scienceworks Museum and walked around the museum before our interview with the Public Programs Manager, Pennie Stoyles, and the Exhibition Manager, Andrew Lewis at 2:00pm. The interview can be found in Appendix E. We entered the Humanoid Discovery Exhibit first and examined the displays. There was a quiz sheet that we picked up in the beginning, which asked simple questions that you could answer through examining the exhibits. The sheet was laid out with circles and boxes, written with a simple text, and was colourful. The quiz sheet was very attractive and we commented on how it would be a great activity to incorporate in the building tour to interest the youth.

We noticed that each display in the museum was simple and interactive. The displays were geared towards the youth but it seemed that they were effective in interesting adults. The displays included several different types of interactivities from just feeling a temperature difference, to lying on a bed of nails to show how they did not hurt you. The displays were also bright and colourful. Each display had an information section that taught you how to use the display and the science behind it; however, each information section was to the point, and interesting. The information always had an interesting fact that would surprise the reader. The information was also displayed in several different blocks and circles on the poster, which allowed the reader the freedom of choosing the sections he/she wants to read rather than reading the entire display.

Journal Entry #8

3 February 2011

Banksia Gardens Community Centre

Introduction to Sustainability Course

At 11:00 am we sat in on the Pilot Introduction to Sustainability Course. Peter Lazarus taught the course. Lazarus believed that there was seven people enrolled in the course, however only three people showed up today. Before the course started Lazarus asked each student why he or she wanted to take the course. One student answered that she wanted to learn more about sustainability so she could "green up her office". Another student was hoping to work in the field of sustainability. The student currently does project work and wants to move into environmental stuff, so she joined the class to get a clearer understanding of the work she could do in the future.

After they had each given their reason for joining the course we explained our project to them and asked what types of displays they would be interested in seeing. They said they would be interested in seeing what sustainable features the centre used, and what is available on the market. They would also be interested in seeing a cost analysis of using sustainable versus non-sustainable features, and a projection showing how the cost of sustainable features could decrease if more people started using them.

Once the course began the students seamed interested and knowledgeable. They had notebooks out, ready to take notes, and were eager to answer the question that Lazarus asked. When Lazarus asked them "What is sustainability?" they answered, "not just how we use resources, but a part of the community and how they react/ interact", "the ability to continue: The entire perception of reality and the reliance that everything has on everything", and "existing without negative impact to food sources". From these answers we could tell that this was not their first time thinking about what sustainability met.

Journal Entry #9

4 February 2011

240 Little Collins Street, Melbourne VIC 3000

Melbourne City Council House 2 Tour

We arrived at the Melbourne City Council House 2 around 10:00am, accompanied by project advisor, Holly Ault. While waited to meet with Warren Knight, we noticed a plaque on the wall, stating that the Council House 2 (CH2) was a six star Green Star accredited office building. We later discovered that CH2 was the first six star accredited building.

Upon meeting Knight he told us a bit of the history of the building. When the City Council decided to create a new building they wanted to make it as sustainable as possible. In order to do this, they had many architects and engineers from all over Australia meet and brainstorm ideas for the building. The architects and engineers were given the challenge to design an innovative office building that trumped the traditional designs. One idea the architects and engineers produced was the principle ways a human body heats and cools itself was applied to the design of the building. Using these principles they came up with a design that circulated fresh, outdoor air through each floor of the buildings, then released it back into the outdoors through ridges and the rippling ceiling.

The building had many simple sustainable features, and many complex features. Knight explained that some simple features were timber around the windows that acts like an insulator. There were dimmed lights near the windows that had a light sensor and would turn up and down depending on the amount of natural light that was being emitted through the windows. The ceilings were made from about one foot thick curved cement. The reason for the thick cement on the ceilings was because cement has a high thermal mass and therefore it absorbs heat from the open office area, keeping the building cool. If the cement absorbs the heat to its capacity, there were cooling plates that are mounted to the cement ceiling that circulated liquid coolant through tubes to cool the cement ceiling. The windows also opened automatically at night to allow fresh cool air to circulate through the building, cooling down the

thick cement ceilings. Also the building was not painted in places where paint was unnecessary, such as the ceilings, because the buildings had a policy that "less is more." By using less paint, Knight said, there was less need to maintenance and fewer pollutants from paint are introduced into the air, therefore creating a better air quality.

Some complex features that were put into the buildings were the non-potable water system, which was used for toilet water and to water the plants, and solar panels located on the roof, which provided the CH2 with energy.

Each side of the building had a special feature. On the left side of the building ivy ran up the balconies. The ivy was used for natural lightning and to help the buildings air quality. The bathrooms were all located on the backside of each floor of the building. The bathrooms were technically on the outside of the buildings to help reduce the amount of ventilation needed in a bathroom. On the right side of the building there was another complex system, which looked like giant showerheads. These showerheads dropped water down the side of the building. Knight explained that as the water fell it cooled. When the water reached the bottom, it is very cold. The water was then collected and circulated through a tank. The tank used the water to chill air, which was then run through the floors of the buildings. Lastly, on the front side of the building there were wooden blinds. These blinds were created to allow natural light into the buildings while keeping out direct sunrays. The blinds had sensors and would shift depending on where the sun was located in the sky.

Other sustainable features that were in the building included a rooftop patio, with plants for employees to go up and eat their lunch, places for employees to store their bikes and shower before work, and large windows surrounded by vines and plants to let in soft natural light. These windows also got smaller as the building got higher, because at the top of the building there was less shade from surrounding buildings, and therefore fewer windows were needed to produce the same amount of natural light that the bottom windows produced. Also there were balconies on each floor of the buildings so employees could easily step outside for a minute to get some fresh air.

Appendix G: Building Tour Photos

Sustainability Victoria Tour

Figure 14: Caged Plant Wall

Figure 15: Rubbish, Recycling and Composting Bins

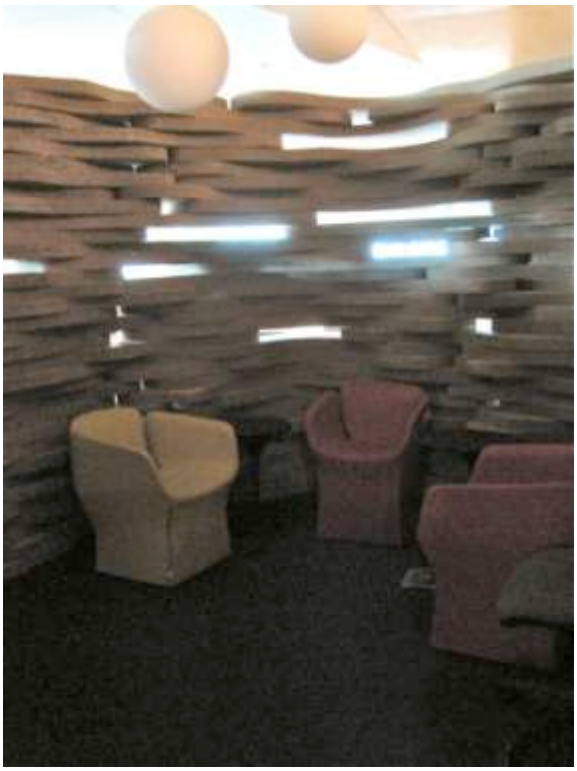

Figure 16: Recycled Structure Made From Refrigerator Boxes

Goods Shed Tour

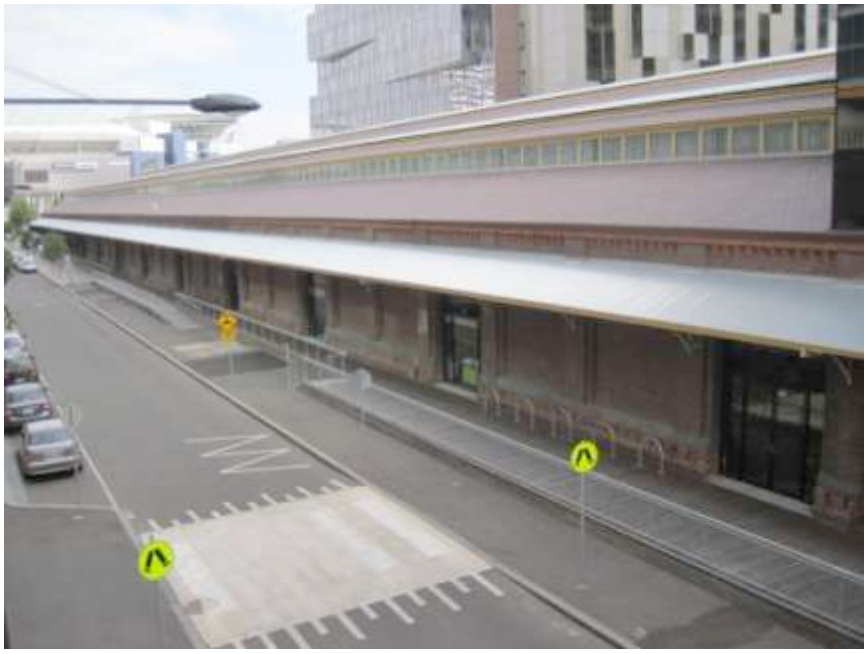

Figure 17: The Goods Shed in the Docklands

Figure 18: Double-glazed windows

Figure 19: Cooling panel

Figure 20: Recycled tyre pieces used as mulch

Council House 2 Building Tour

Figure 21: Melbourne Council House2

Figure 22: Lobby with curved ceilings to help air circulation and heating and cooling of the building

Figure 23: Shutters that adjusts depending on the angle of the sun and outdoor temperature

Figure 24: Rain showers that help cool the building

Figure 25: Outside on the deck looking at the top of the showers

Figure 26: Sink

Figure 27: Bicycle rack in the car park

Figure 28: Towel closet for employees that blow air through the vents to dry them

Figure 29: Shower for employees

Figure 30: Pipe circulating recycled water in the shower rooms

Figure 31: Unpainted walls that do not release harmful pollutants and needs very little maintenance

Figure 32: Rock foundation that was not blasted away; therefore, money was saved and environmental footprinting was reduced

Figure 33: Rooftop of the Council House2 with wind turbines

Figure 34: Wind turbine

Figure 35: Foliage on the rooftop

Figure 36: Solar panels on roof

Figure 37: Green Star accreditation plaque in the lobby of Council House2

Figure 38: Water vortex display in the lobby

Figure 39: Showers from the street

Figure 40: Wooden shutters from the street

Figure 41: Overhanging toilet blocks for ventilation

Figure 42: Balconies from the street

Appendix H: Interactive Displays at Scienceworks

Figure 43: Start of self guided tour for the Humanoid Discovery displays

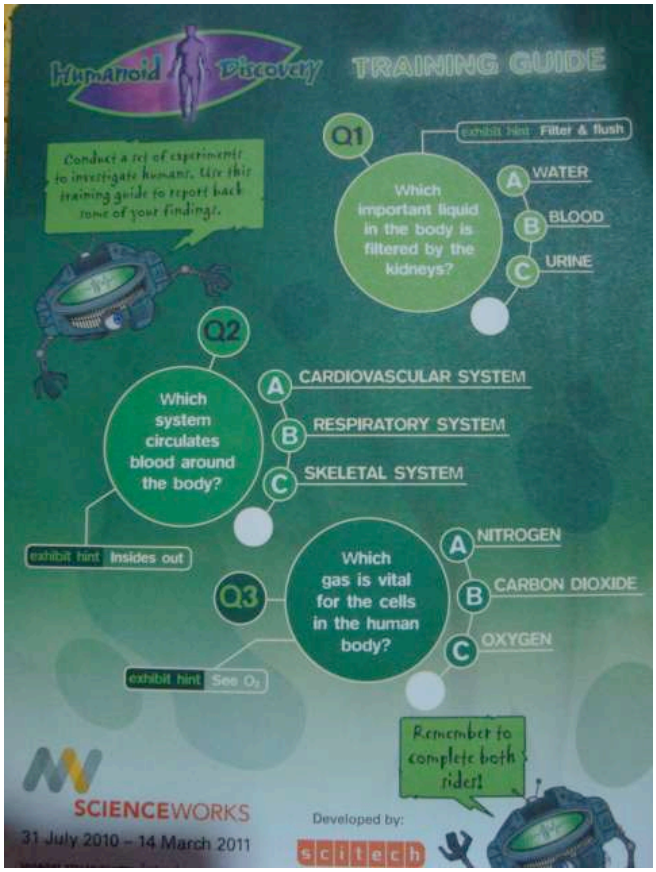

Figure 44: Humanoid Discovery Quiz front

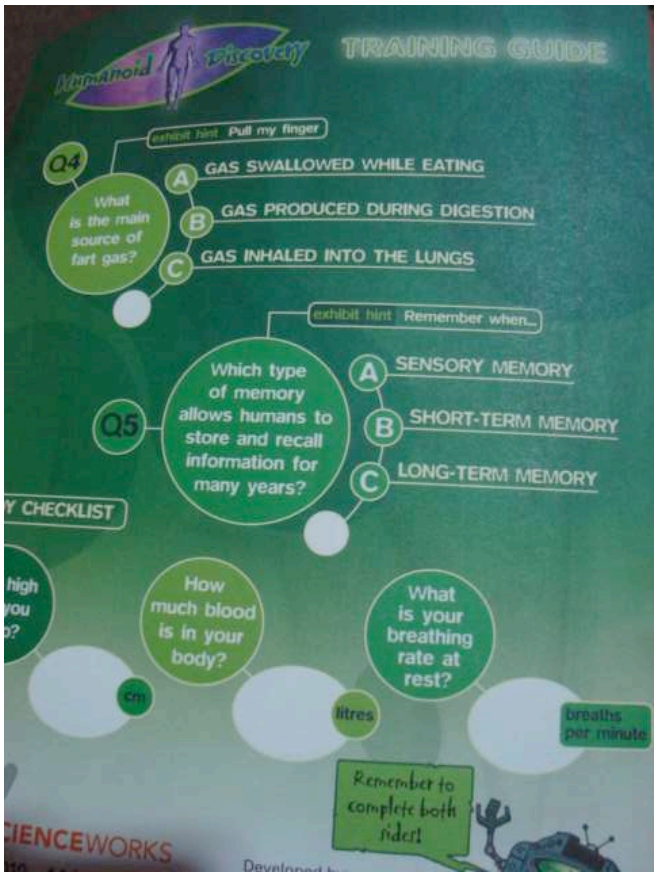

Figure 45: Humanoid Discovery Quiz back

Figure 46: Body of Water display

Figure 47: A Wide View display

Figure 48: Aim High display

Figure 49: Dial a Desire display

Figure 50: Racing activity in SportsWorks display area

Figure 51: Sorting recycling section of the Recyclatron displays

Figure 52: Sorting plastic bottles in the Recyclatron displays

Figure 53: Strengthening display of the West Gate Bridge display

Figure 54: Safety display of the West Gate Bridge display

Figure 55: Construction display of the West Gate Bridge display

Figure 56: Water Wasted display

Appendix I: Pairwise Comparison Chart for Criteria, Weight Factors, and Rubric

Pairwise Comparison Chart

Criteria	Cost	Time	Self Maintenance	Aesthetic	Risk	Personal Relevance	Ease of Use	Versatility	Interactivity	Total Score
Cost		0	0	0	0	0	0	0	½	.5
Time	1		0	0	0	1	0	0	½	2.5
Self Maintenance	1	1		1	0	1	1	1	1	7
Aesthetic	1	1	0		0	1	½	1	1	5.5
Risk	1	1	1	1		1	1	1	1	8
Personal Relevance	1	0	0	0	0		½	0	1	2.5
Ease of Use	1	1	0	½	0	½		1	1	5
Versatility	1	1	0	0	0	1	0		1	4
Interactivity	½	½	0	0	0	0	0	0		1

Table 3: Pairwise Comparison Chart

Weight Factors

We determined our weight factors mathematically by using proportions. We looked at the score each criterion obtained in the pairwise comparison and divided by eight. We chose eight because each criterion was ranked against eight other criteria. The number obtained from this simple mathematical operation was then multiplied by 100. This gave us a number that we could use on the rating scale we created. Each number we obtained was rounded off to the nearest five or ten. We then slightly adjusted our number to have three criteria fall into each group on the weighting scale

Criteria	Pairwise Score	Normalised Score (÷ 8)	Weight Factor (×100)	Final Weight Factors
Risk	8	1	100	100
Self-Maintenance	7	0.875	87.5	90
Aesthetics	5.5	0.6875	68.75	75
Ease of Use	5	0.625	62.5	65
Versatility	4	0.5	50	50
Personal Relevance	2.5	0.3125	31.25	35
Time	2.5	0.3125	31.25	35
Interactivity	1	0.125	12.5	15
Cost	0.5	0.0625	6.25	10

Table 4: Criteria Scoring

Criteria Rubric

	0	2	4	6	8	10
Cost	$3000 or higher	$3000-$2000	$2000-$1000	$1000-$850	$850 - $500	0 - $500
Time *per display	Takes 3 or more weeks to complete	Takes 2-3 weeks to complete	Takes 1-2 weeks to complete	Takes 4 -5 days to complete	Takes 2-3 days to complete	Takes 1 day or less to complete
Self Maintenance *business days	Requires employee to manage it at all times	Requires daily maintenance	Requires weekly maintenance	Requires monthly maintenance	Requires bimonthly maintenance, or replacing light bulbs etc.	Self sustaining: Requires no maintenance
Aesthetic	Does not look interesting, does not catch your attention, is not visually appealing and is made of poor quality materials and looks like very poor craftsmanship	Catches audiences attention but not interesting and looks like a poorly constructed middle school project	Catches audiences attention but not interesting to everyone but looks well made	Catches audience attention and looks interesting and looks like it is made of common materials by an average person	Catches audience attention and everyone is interest made of 2nd best materials looks almost professionally made	Interests all target groups, catches attention right away, looks professionally made and is made of top quality materials
Personal Relevance	No one can understand or relate to the information	No one can relate but 1 target group can understand	Two target groups can understand but only 1 can relate	Two target groups can relate and understand	All 3 of our target groups can understand but only 2 can relate	All of our target groups can understand and relate
Ease of use	No one can figure out how to use	Very complicated to use for people with a high education and	All groups can figure out how to use it with help	One group can figure out how to use on their own	Two groups can figure out how to use on their own	All of our target groups can use without help
Versatility	Doesn't fit any target group	Fits the interested and educated target group	Fits the interested and educated and interested but uneducated group	Fits uneducated and uninterested group	Fits uneducated and interested group and uneducated and uninterested group	Fits all target groups
Interactivity	No interactivity at all: cant touch, feel or see, no pictures only text	Display that only has pictures	Display that has pictures and words	Display where you can see or watch to understand how something works	Display where you can touch or feel to understand	Fully immersed in activity: can touch, feel and see with own body
Risk	There is a risk of death while participating. (e.g. jumping from a high height, playing with explosives)	Displays have small parts that can be removed, materials that can be removed and used as a weapon, sharp objects and open electrical circuits	Displays do not have small materials that can be removed and used as a weapon but does have open electrical circuits	Displays have closed electrical circuits and sharp objects but no materials that can be removed and used as weapons	Displays contain sharp corners but not sharp objects, dangerous electrical circuits or objects that can be used as weapons	There is no foreseen risk. All displays contain no sharp objects, sharp edges, objects that could be used as weapons or other harmful things

Table 5: Criteria Rating Factor Rubric

Appendix J: Display Descriptions

1. Self-Guided Tours
    a. Place: Around the Community Centre
    b. Description: In the hall when you enter there will be our informational poster display that has a map showing where each acrylic display is. There will be ten acrylic plaques each stationed at a sustainable feature in the centre. The acrylics will have a small explanation about the feature and an interesting "Did You Know?" fact.
    c. Materials: "Did You Know?" facts, feature explanations, template, acrylics, bolts, and printing.

2. "What am I?" Scavenger Hunt
    a. Place: In the front hall where the informational posters are.
    b. Description: There will be two double-sided sheets each with five multiple-choice "What Am I?" questions, and three fact questions. The "What Am I?" questions and the fact questions will correlate with the self-guided tour posters. This sheet will be a fun way for the kids to go through the building tour.
        i. Example: "I once looked like a tree, and now you step on me. What am I?"
            1. Bamboo flooring
            2. Solar panels
            3. Insulation
        ii. Example: How tall can bamboo grow in 1 day? ___ metres
    c. Materials: Template, "What Am I" questions, Facts, and printing.

3. Insulation Temperature Difference Demonstration
    a. Place: Play room
    b. Description: Have a heater lamp in a box. One side of the box will be insulated, and the other side will not. The top of the box will then be shut in by a piece of aluminium. People will be able to put their hands on the aluminium and feel how the side with insulation is not as warm as the side without insulation.
    c. Materials: heat lamp, plexi-glass box, aluminium, insulation

4. Rolling Facts
    a. Place: Computer screen and or website
    b. Description: 30-50 facts - "Did you know?", statistics, and wow facts (about sustainability) - that will bounce around a screen-saver and switch every 20 to 30 seconds so that people learn bits of information while either on the website or at the computers.
    c. Materials: facts, and some kind of computer program

5. Plants Around the Building
    a. Place: all around the building
    b. Description: Different green, easily maintained plants are placed around the building. The pots are painted green because Banksia Gardens is going green.
    c. Materials: plants, pots, potting mix, mulch, and spray paint.

6. Recycled Materials Sculpture
    a. Place: Front door of the centre or courtyard
    b. Description: A sculpture of a 1.5-metre tall tree made out of recycled plastic bottles and cans. The tree will have laminated paper facts hanging off of it. These

facts you can pick off the tree and each one will have a simple way to save money.
    c. Materials: recycled plastic bottles, cans, hot glue gun with glue, facts and string.

7. Mini Model House
    a. Place: New classroom
    b. Description: A mini model of a house is built with art supplies. The model will include insulation (aluminium) between the walls (2 pieces of foam board or cardboard). A removable awning can be made out of cardboard and incorporated into the design. Using a heat lamp and angling it differently to simulate the sun during different seasons, you can test how effectively the insulation and awning retains or reflects heat from the house.
    c. Materials: Foam board, aluminium, shingle, saran wrap, thermometer, heating lamp

8. Double or Single Glazed Window Comparison
    a. Place: Hall of centre, play room, or new classroom
    b. Description: Similar to the temperature difference idea. Have a heater lamp in a box. One side of the box will have a double glazed window, and the other side will have a single glazed window. People will be able to put their hands on the glass and feel how the side with the double glazed window is not as warm as the side with the single glazed window.
    c. Materials: Plexi-glass box, heat lamp, double glazed window, and a single glazed window.

9. Follow the Path to the Grass
    a. Place: Corral
    b. Description: Using the top ten or fifteen species of plants in the corral make a path of questions (one question which breaks off into two answers, which then each asks a question which breaks off again). A person can pick a species out of the corral and follow the question path to figure out what the species of plant they have. At the bottom when they figure out the plant they can also read a little description about what it is.
    c. Materials: Plexi-glass over the poster to keep it dry, and descriptions of the top 15 plants.

10. Solar Panel Reading
    a. Place: Near the solar panels
    b. Description: The screen of the solar panel that shows the amount of energy produced. This activity will simply have the people reading the wattage the panels have produced, daily and/or annually
    c. Materials: Solar panel

11. Water Tank Promotional Poster
    a. Place: Either by the water tank or on the glass windows by the couches.
    b. Description: A poster of the Turkish Lady with here bins that she uses to collect rainwater. The poster will have a sentence that says why she is sustainable.
    c. Materials: Picture, template and either a vinyl poster or a decal.

12. Community Gardens Promotional Poster
    a. Place: Either at the gardens or on the glass windows by the couches.
    b. Description: A poster of the community gardens workers at the garden. The poster will have a sentence that says why they are sustainable.
    c. Materials: Picture, template and either a vinyl poster or a decal.

13. Transportation Promotional Poster
    a. Place: Either at the bike rack or on the glass windows by the couches.
    b. Description: A picture of a community member who riders their bike instead of using a car. The poster will have a sentence that says why he or she is sustainable.
    c. Materials: Picture, template and either a vinyl poster or a decal.

14. Window Blinds Promotional Poster
    a. Place: Either inside the classroom or on the glass windows by the couches.
    b. Description: A picture of Peter Lazarus with his window shades. The poster will have a sentence that will say why he is sustainable
    c. Materials: Picture, template and either a poster or a decal.

15. Recycling and Turn Off Lights Promotional Poster
    a. Place: On the glass windows of the office.
    b. Description: A picture of a community member recycling and/or turning off a light. The poster will have a sentence that will say why he or she is sustainable.
    c. Materials: Picture, template and a decal.

16. Tyre Pebbles in Plant Pots
    a. Place: plant pots
    b. Description: Recycled tyre bits that work as a type of mulch to keep in the water as well as decor
    c. Materials: recycled tyre pebbles

17. Video Showing The Strength Difference Between Bamboo And Other Materials Such As Steel, Concrete, And Woods
    a. Place: computer screens or Banksia website
    b. Description: Some type of video showing the strength of bamboo vs. other materials such as steel, concrete, oak and maple wood. This could possible be a funny little karate stunt where the person can break all the other materials but not the bamboo.
    c. Materials: Video camera, actors, editing software, karate suit and ideas.

18. Sustainability Promotional Video
    a. Place: computer screens or website
    b. Description: A 40 second clip of the intro to the JET song “Are You Going To Be My Girl”. The song starts slow and then picks up. There will be three clips that start slow and then pick up. The clips will be of someone recycling, someone taking alternative transportation, and someone turning off the lights. At first the people will be doing these motions slow and as the energy of the song picks up so does their energy. By the end they will be doing them fast. At the end of the lights clip it can go black because they turned off the last light. At the end of the transportation clip they can arrive at the community centre, and at the end of the recycling clip a bottle can be going into the bin.
    c. Materials: Video camera, editing software, and actors.

19. Temperature Difference In Rooms
    a. Place: Function hall, old classroom, and new classroom.
    b. Description: There will be three thermometers that show the difference between the function hall, which has insulation, the regular hall, which has no insulation, and the new classroom that has insulation and passive design.
    c. Materials: 3 thermometers.

20. Cost Analysis Poster
    a. Place: Lobby or function hall
    b. Description: A poster set up to look like a nutrition facts box that you see on all foods. In the poster instead of having nutrition facts will actually be different materials and the percent of money that they can save you per year. For example how using a reusable water bottle with tap water can save you X amount of money.
    c. Materials: Poster and facts.

21. Bike to Light Bulbs
    a. Place: Bicycle shed, courtyard
    b. Description: Pedal a bike until you light up a string of lights. Some of the lights will be fluorescent bulbs and some will be incandescent bulbs. This shows how much energy it takes to light a light bulbs, and the different amounts of energy it takes to light up a fluorescent bulb versus an incandescent bulb.
    c. Materials: Old bike, dynamo, fluorescent and incandescent bulbs, magnets, and electrical wires.

22. Recycling Centre
    a. Place: Courtyard space between the buildings or hall
    b. Description: A large wooden box that holds three bins. There will be a door to take out each bin and a hole in the top that goes to each bin. The system will be painted to show what goes in each bin.
    c. Materials: paint, bins, plywood, nails, 2 X 4's, screws, hinges, nails, hammer, saw, screwdriver, saw, tape measure, and other wood.

23. Worm Farm Composting Display
    a. Place: Garden, compost pile
    b. Description: A warm farm with a poster describing it.
    c. Materials: worms, bin, dirt, and poster

24. Big Bag of Money Game
    a. Place: Computer room and website
    b. Description: A computer game where someone gets to build a house. To build the house they will get to pick the orientation of the house, the materials used to make it, the furniture and appliances that go in it. The game will deduct money from an account as the person buys things for their house, however it will also give back money to show the money that the person would make back from using sustainable materials.
    c. Materials: Software, script and an imagination

25. Water Dripping Display
    a. Place: Bathroom/kitchen
    b. Description: Some faucet that drips water. The water will get collected in a basin, which is marked with the different litres. As the water dripping reaches new litres marks it will show what the wasted could be used for. For example: 1 litre could be used to brush your teeth.
    c. Materials: tube, pump, faucet head, bison and water facts.

26. The Tile Slider Game
    a. Place: Play Room
    b. Description: The tile slider game that you see with numbers where you have to line them up 1-9, or you have to unscramble the picture. We would make this of

a picture with a fact about the picture and people can unscramble it to learn the fact.

c. Materials: Not really sure how to make this one.

27. Informational Posters
    a. Place: Big empty green wall to the left of the hall directly in front of the main entrance
    b. Description: Six different posters that have information about water, climate change, pollution, composting, recycling, and energy. Three of the posters will be A3 sized and three are A4. There will also be a centre A2 sized poster that talks about the Eco-Warrior Project and the funding body for the project. The posters will be printed on recycled paper.
    c. Materials: Three A2 posters, three A3 posters, and one A2 poster, frames for each, and recycled paper

28. Fluorescent-Incandescent Light Bulb Comparison Demonstration
    a. Place: New classroom
    b. Description: There will be two circuits one with 5 florescent light bulbs, and one with incandescent light bulb. The circuit will show how it uses as much energy to light up one incandescent light as it does to light up five florescent light bulbs.
    c. Materials: Five florescent light bulbs, one incandescent light bulb, electrical circuit, and something that shows the energy travelling through the circuit.

29. Sustainable Person of the Month
    a. Place: Front of the building
    b. Description: Each month a person will get picked who has acted in ways that are eco friendly. Their picture will get up put on the wall in a poster that looks something like an employee of the month poster.
    c. Materials: Poster, template, and staff who selects the person of the month.

Appendix K: Decision Matrix

		Risk	Self Maintenance	Aesthetics	Ease of Use	Versatility	Personal Relevance	Time	Interactivity	Cost	TOTAL
Display Name	**Display Number**	100	90	75	65	50	35	35	15	10	
Self-Guided Tours	1	8/800	10/900	8/600	10/650	4/200	10/350	8/280	6/90	6/60	3930*
What Am I? Scavenger Hunt	2	10/1000	8/720	8/600	10/650	8/400	8/280	8/280	6/90	10/100	4120*
Insulation Temperature Difference Demonstration	3	6/600	2/180	8/600	10/650	10/500	10/350	8/280	8/120	10/100	3380
Rolling Facts	4	10/1000	10/900	8/600	10/650	4/200	8/280	6/210	0/0	10/100	3940*
Plants Around the Building	5	10/1000	8/720	8/600	10/650	10/500	10/350	8/280	4/60	8/80	4240*
Recycled Materials Sculpture	6	8/800	10/900	8/600	10/650	10/500	10/350	4/140	4/60	10/100	4100*
Mini Model House	7	8/800	8/720	8/600	8/520	10/500	6/210	4/140	10/150	8/80	3720
Double or Single Glazed Window Comparison	8	6/600	2/180	8/600	10/650	10/500	8/280	6/210	8/120	10/100	3240
Follow the Path to the Grass	9	8/800	10/900	6/450	10/650	10/500	6/210	6/210	6/90	10/100	3910
Solar Panel Reading	10	6/600	10/900	8/600	8/520	4/200	4/140	8/280	0/0	10/100	3340
Water Tank Promotional Poster	11	10/1000	10/900	10/750	10/650	10/500	10/350	8/280	4/60	10/100	4590*
Community Gardens Promotional Poster	12	10/1000	10/900	10/750	10/650	10/500	10/350	8/280	4/60	10/100	4590*
Transportation Promotional Poster	13	10/1000	10/900	10/750	10/650	10/500	10/350	8/280	4/60	10/100	4590*
Window Blinds Promotional Poster	14	10/1000	10/900	10/750	10/650	10/500	10/350	8/280	4/60	10/100	4590*
Recycling and Turn Off Lights Promotional Poster	15	10/1000	10/900	10/750	10/650	10/500	10/350	8/280	4/60	10/100	4590*
Tyre Pebbles in Plant Pots	16	6/600	8/720	8/600	10/650	10/500	10/350	6/210	2/30	10/100	3760
Bamboo vs. Wood/Steel Video	17	10/1000	10/900	6/450	10/650	4/200	8/280	4/140	6/90	8/80	3790
Sustainability Promotional Video	18	10/1000	10/900	8/600	10/650	10/500	10/350	8/280	6/90	10/100	4470*
Temperature Difference in Rooms	19	8/800	10/900	2/150	10/650	8/400	8/280	10/350	4/60	10/100	3690
Cost Analysis Poster	20	10/1000	10/900	4/300	10/650	4/200	8/280	8/280	0/0	10/100	3710
Bike to Light Bulbs	21	8/800	8/720	10/750	10/650	10/500	10/350	6/210	10/150	10/100	4230*
Recycling Centre	22	8/800	10/900	10/750	10/650	10/500	10/350	8/280	8/120	10/100	4450*
Worm Farm Composting Display	23	8/800	8/720	8/600	10/650	6/300	6/210	4/140	6/90	10/100	3610
Big Bag of Money Game	24	6/600	10/900	10/750	10/650	10/500	8/280	2/70	6/90	8/80	3920
Water Dripping Display	25	8/800	6/540	8/600	10/650	10/500	10/350	6/210	6/90	8/80	3820
The Tile Slider Game	26	8/800	10/900	10/750	10/650	6/300	6/210	2/70	2/30	10/100	3810
Informational Posters	27	10/1000	10/900	10/750	10/650	4/200	10/350	6/210	4/60	6/60	4180*
Fluorescent-Incandescent Light Bulb Comparison	28	6/600	8/720	8/600	10/650	10/500	10/350	8/280	6/90	10/100	3890
Sustainable Person of the Month	29	10/1000	6/540	8/600	8/520	2/100	8/280	8/280	4/60	10/100	3480

Table 6: Decision Matrix

The first number of each scoring is the rating factor that the display received for each criterion. The bolded number is the product of the rating factor and the weight factor. These numbers are summed for each row and the total score is shown on the right column. Scores accompanied with an asterisk (*) correspond with the displays we selected to create for Banksia Gardens Community Centre. Table 7 below, shows the results of the decision matrix:

Display Name	Display Number	Score
Promotional Posters	11-15	4590
Sustainability Promotional Video	18	4470
Recycling Centre	22	4450
Plants Around the Building	5	4240
Bike to Light Bulbs	21	4230
Informational Posters	27	4180
“What am I?” Scavenger Hunt	2	4120
Recycled Materials Sculpture	6	4100
Rolling Facts	3	3940
Self-Guided Tours	1	3930

Table 7: Top ten display and activity ideas

However, due to unforseen constraints, we completed a total of six of the top ten displays.

Appendix L: Promotional Posters

Figure 57: Turn off lights

Figure 58: Homemade water tanks

Figure 59: Community gardens

Figure 60: Recycle

Figure 61: Sustainable transportation

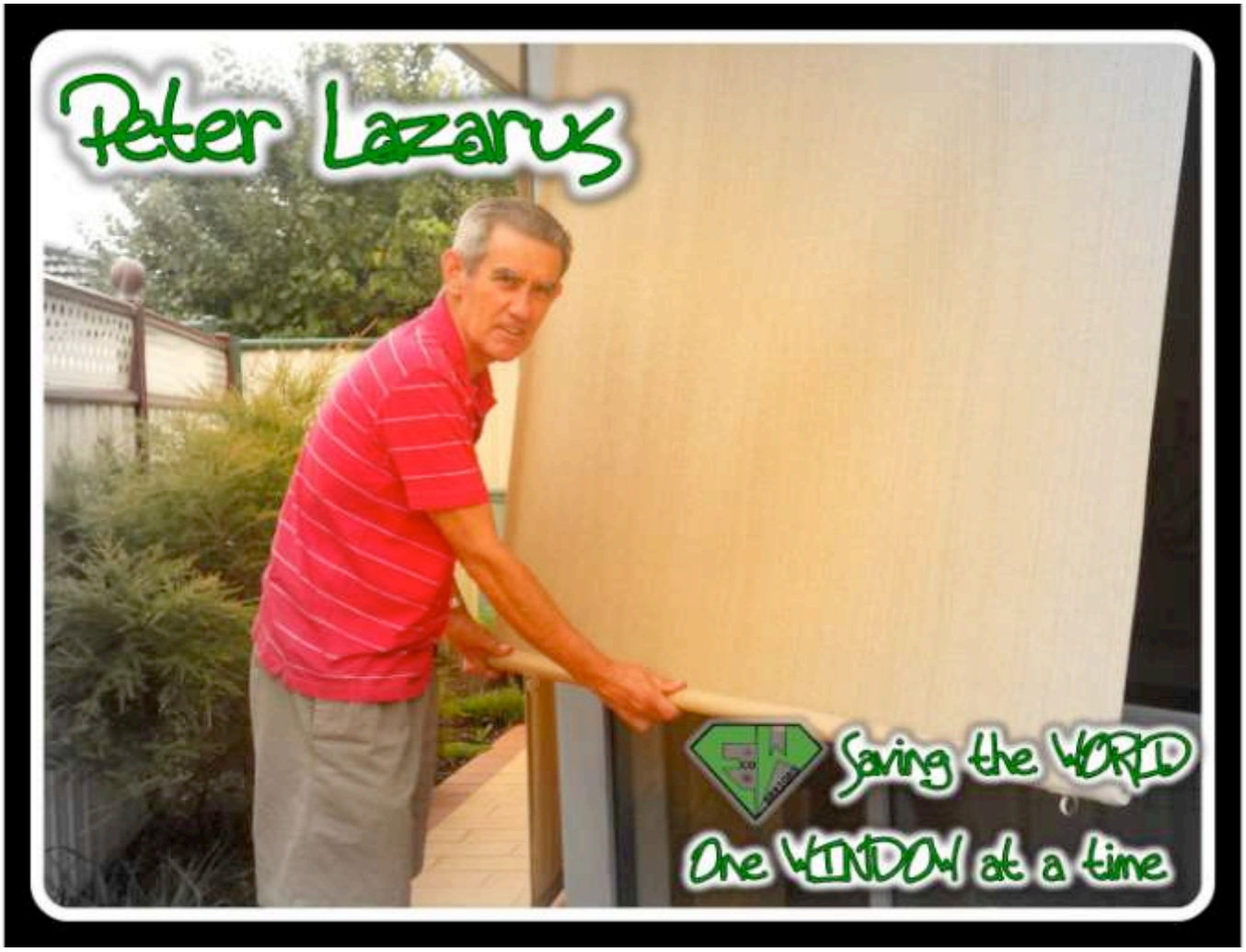

Figure 62: Save energy using window blinds

Figure 63: Promotional posters displayed

Appendix M: Informational Posters

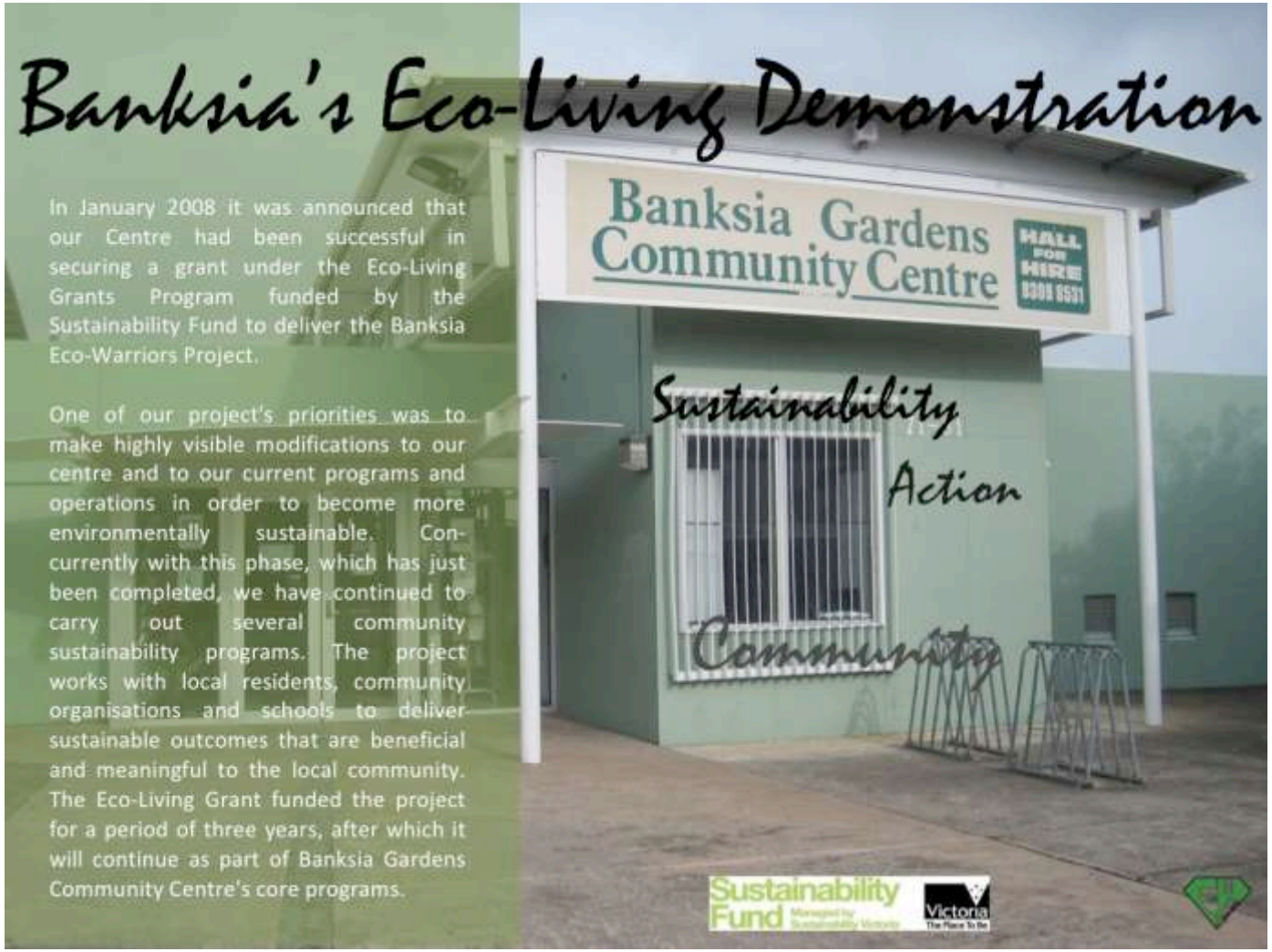

Figure 64: Banksia's Eco-Living Demonstration Poster

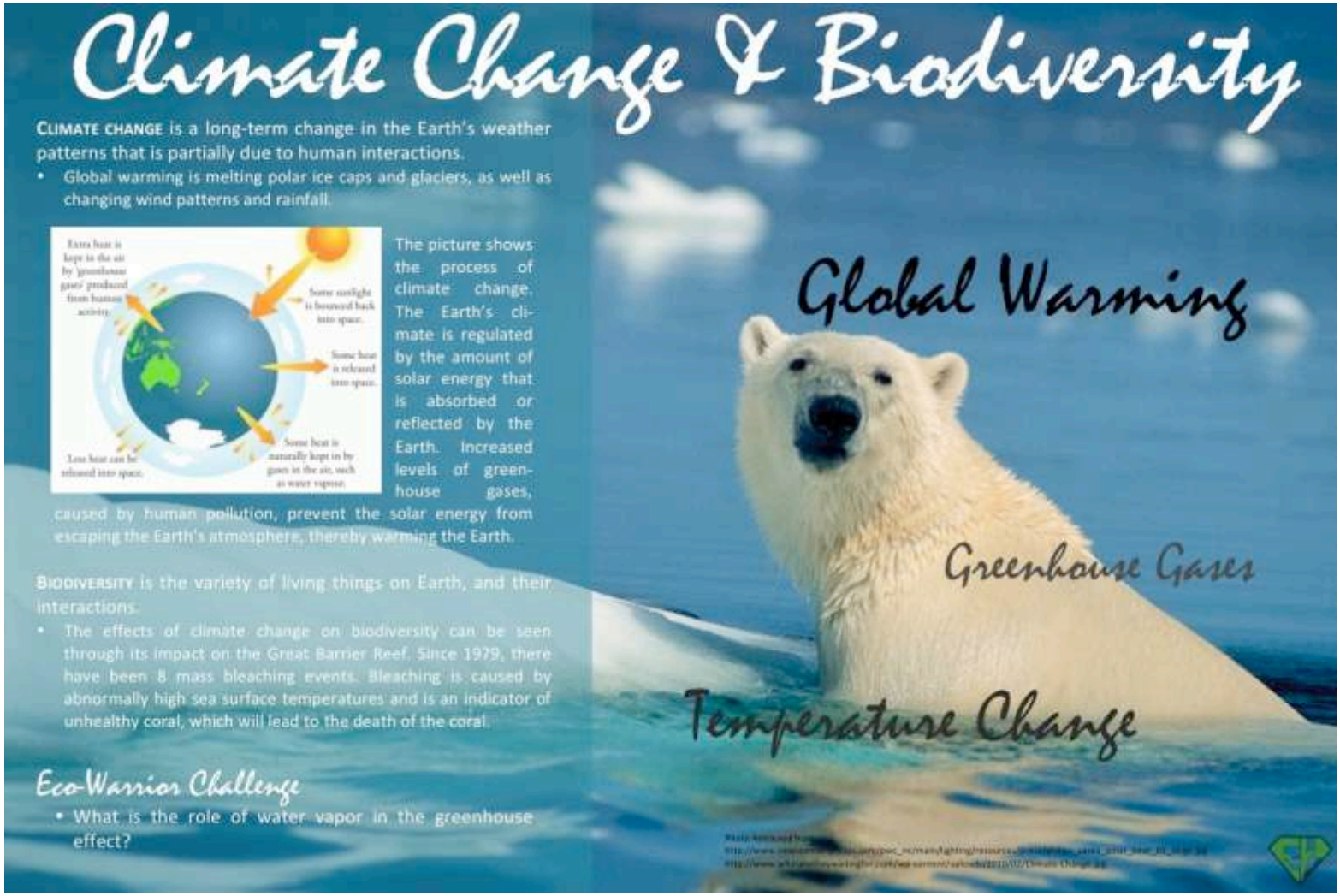

Figure 65: Climate Change and Biodiversity Poster

Figure 66: Composting Poster

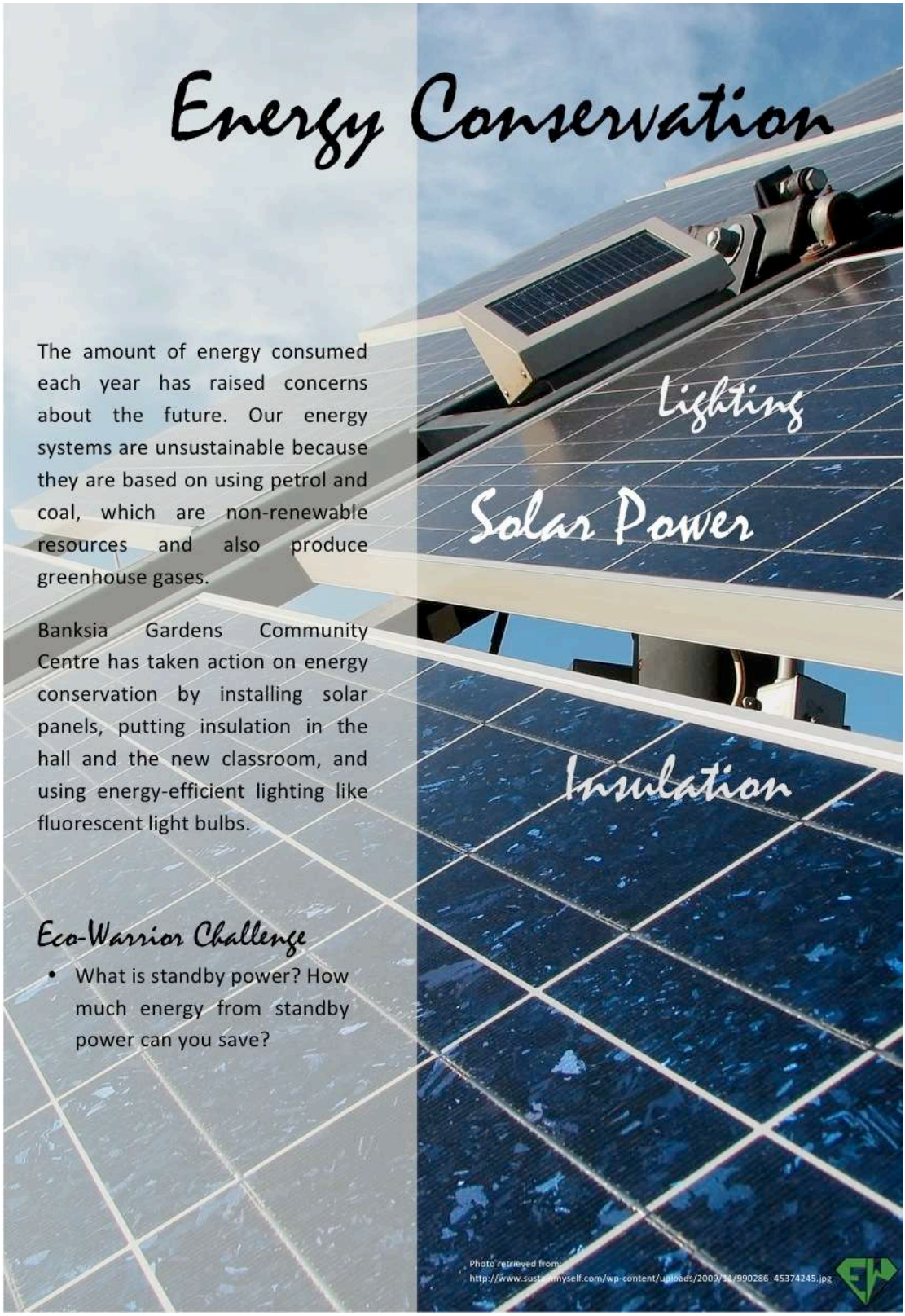

Figure 67: Energy Conservation Poster

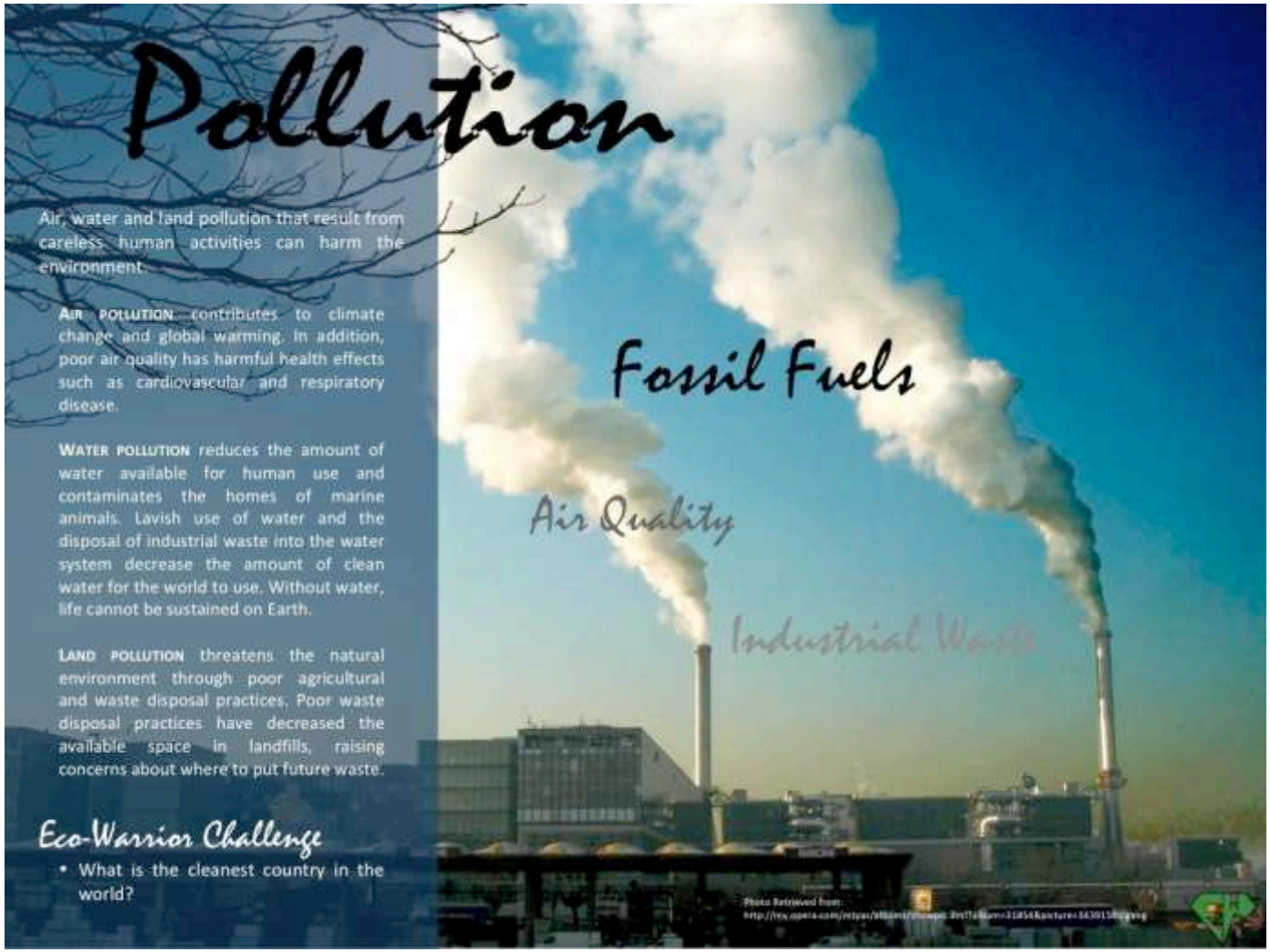

Figure 68: Pollution Poster

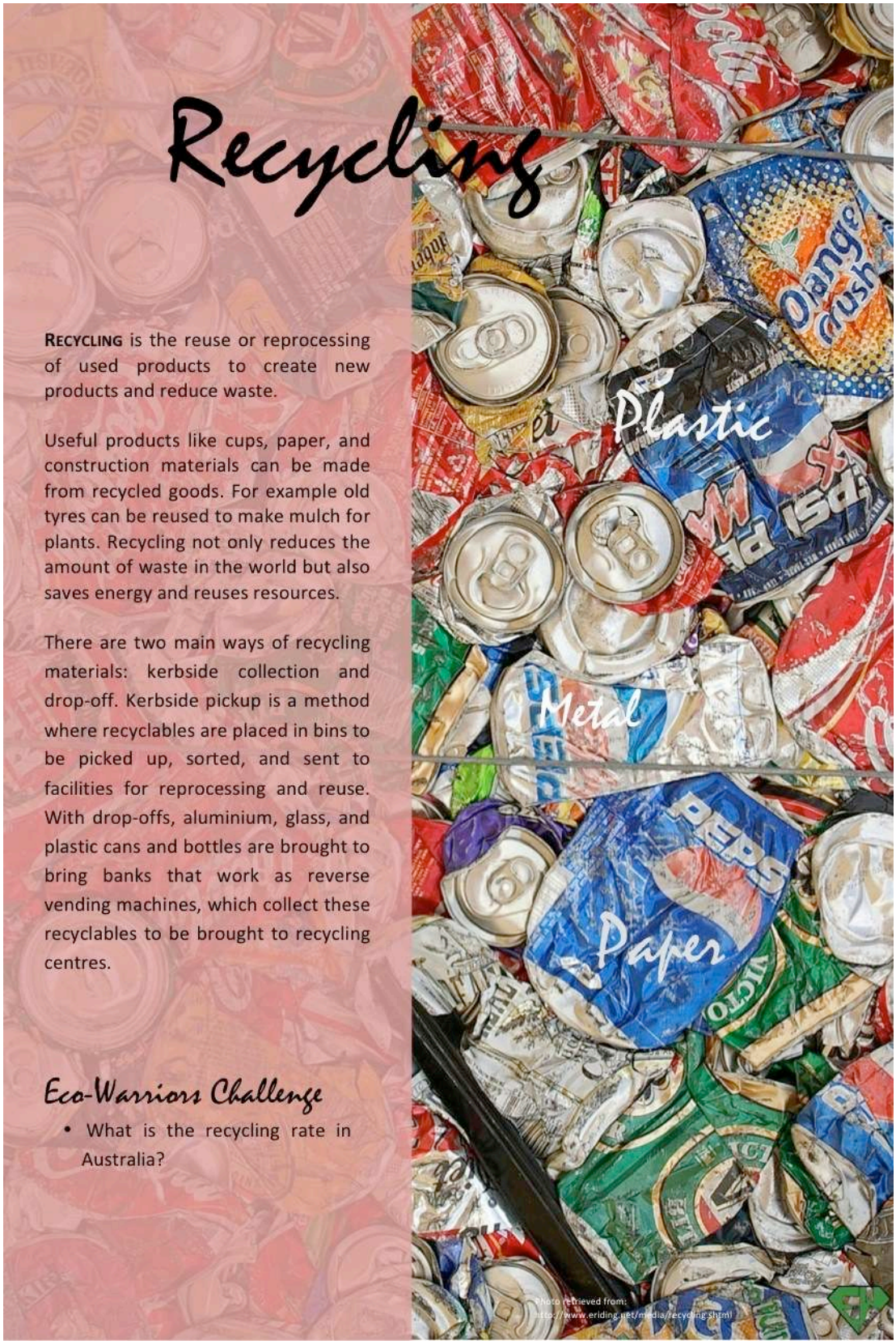

Figure 69: Recycling Poster

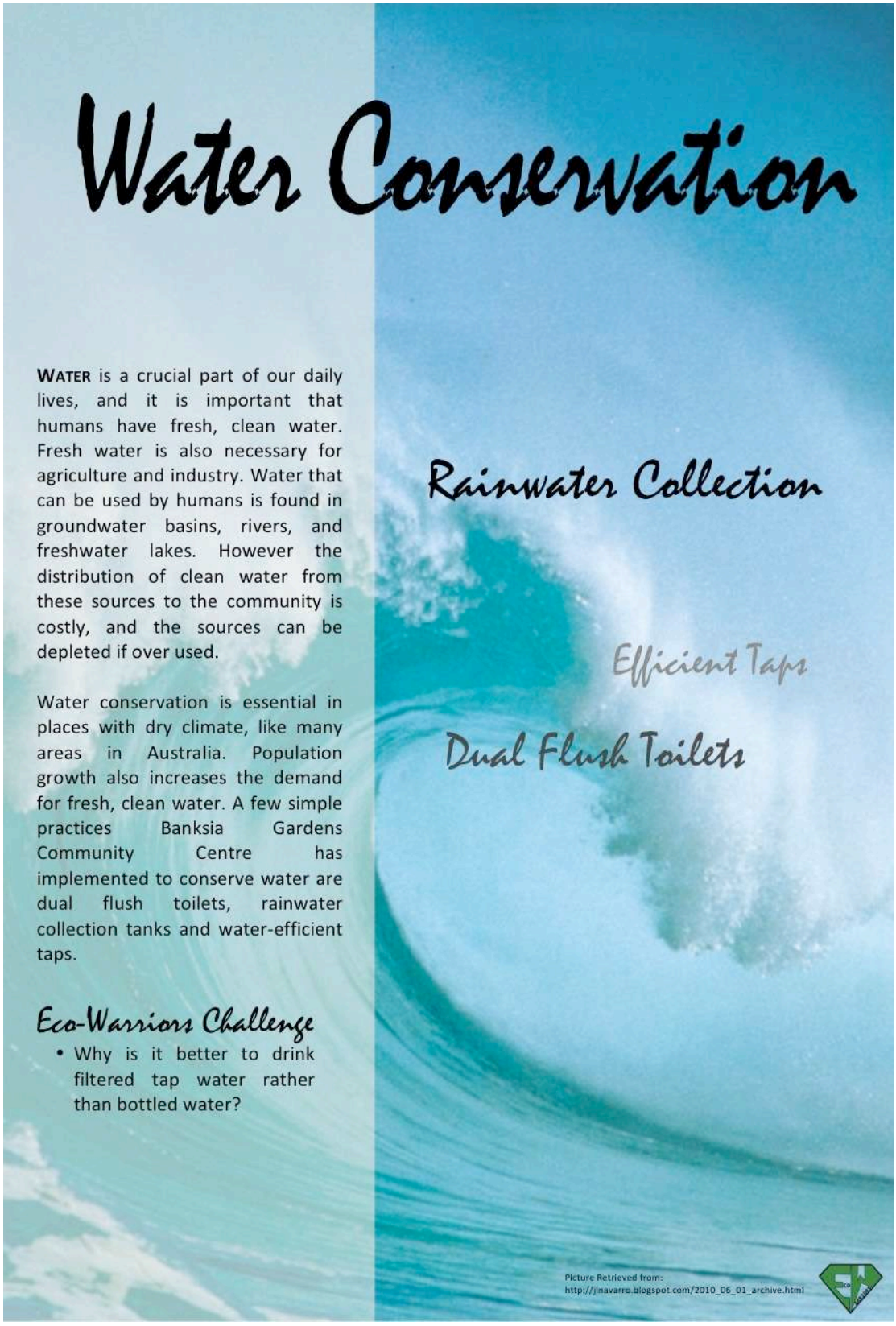

Figure 70: Water Conservation Poster

Figure 71: Acknowledgements Poster

Figure 72: Informational posters displayed

Appendix N: “What am I?” Quiz Sheets

Figure 73: "What am I?" Quiz 1, Front

Figure 74: "What am I?" Quiz 1, Back

Figure 75: "What am I?" Quiz 2, Front

Figure 76: "What am I?" Quiz 2, Back

Appendix O: Plants Around the Building

Cocos Palm

Figure 77: Cocos Palm

Cocos Palms, now regarded as a weed in Australia, is a resilient plant. It can tolerate little water, cold weather, and shallow soil. This palm has a skinny trunk with feathery green leaves (Norwood, 2011). It can grow to be 12 meters tall and has small yellow and orange fruit (Gardening Australia, 2011). When growing it indoors it is best to keep it in a cool area with partial light. It likes moderate watering and to be fed regularly. (Norwood, 2003)

Flamingo Flowers

Figure 78: Flamingo Flowers

Anthuriums, more commonly known as Flamingo Flowers, are great indoor plants. They have big green leafs with flowers that can be red, white or pink (Norwood, 2011). Their flowers bloom year round, and work to filter air (Lowes, 2011). Anthuriums like to be kept in well-lit, warm areas. They grow best when their soil is moist in the summer and dry in the winter (Norwood, 2008).

Parlour Palms

Figure 79: Parlour Palm

Parlour palm is a popular choice for an indoor plant because it can survive in low light and dry climates (Thomas, 2011). It is also a popular choice because this plant will help improve air quality (Gardner, 2010). The plant has dark green leave with small yellow flowers. It likes to be kept in indirect sunlight or full shade. Parlour Palms also need to be placed in warm areas and occasionally watered (Norwood, 2009).

Variegated Shell Ginger

Figure 80: Variegated Shell Ginger

The Variegated Shell Ginger, from the Zingiberaceae family, is native to India. It has yellow and green striped leave that grow to be about 1.8 meters tall. This plant also has white-pink flowers (Floridata, 2010). Its roots, called rhizomes are relatively thick. Variegated Shell Ginger plants will grow in conditions from sun to shade, and likes moist soil (Focus on our Gardens: Shrubs, 2011))

Yucca Elephantipes

Figure 81: Yucca Elephantipes

Yucca Elephantipes originate from the Mexico and Guatemala (InfoBarrel, 2001). They look tropical and grow to the size of a small tree. Yucca Elephantipes are easy to care for. They will grow in either an indoor or outdoor climate, and can be placed in a sunny or shady area (Yucca Elephantipes, 2011). Yucca Elephantipes need water when the soil feels dry, and to be fertilise occasionally (Yucca Elephantipes, 2011; InfoBarrel, 2011). Yucca Elephantipes are not only easy to care for but they are also great indoor plants because they help improve the air quality and keep insects away. (Vecchioni, 2010)

Figure 82: Plant labels

Appendix P: Recycling Centre

Figure 83: Frame of recycling centre

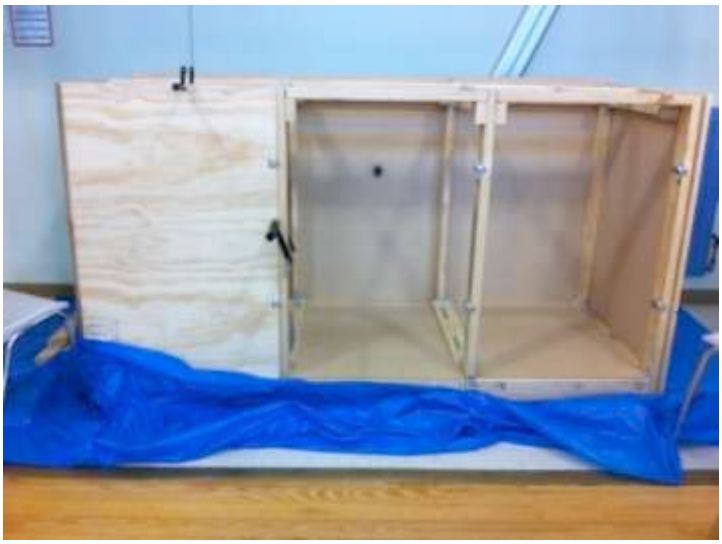

Figure 84: Recycling centre under construction

Figure 85: Almost completed recycling centre

Figure 86: Side view of finished recycling centre

Figure 87: Completed recycling centre with top doors open

Figure 88: Completed recycling centre

Figure 89: Painted doors of recycling centre

Appendix Q: Self-Guided Tour Displays

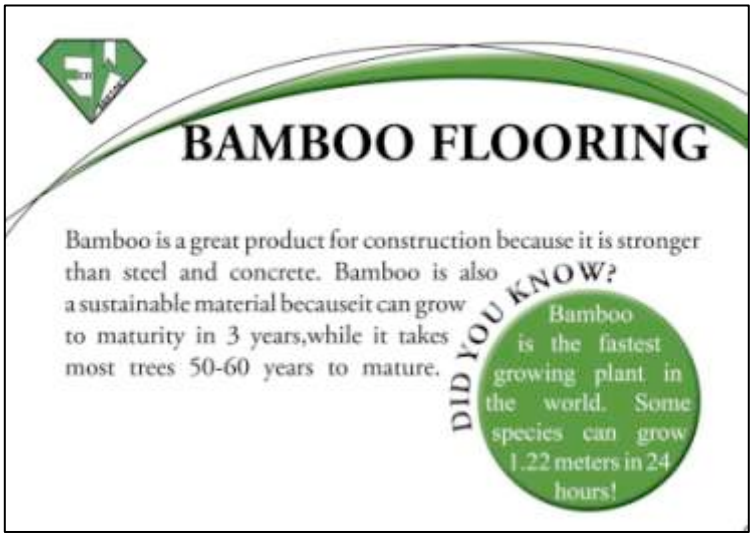

Figure 90: Sample proof of acrylic self-guided tour displays

The following is the information that is contained on our acrylic displays

Bamboo Flooring

- Bamboo is a great product for construction because it is stronger than steel and concrete. Bamboo is also a sustainable material because it grows to maturity in 3 years, while it takes most trees 50-60 years to mature.
    - **Did you know?** Bamboo is the fastest growing plant in the world. Some species can grow 1.22 metres in 24 hours!

Double Glazed Windows

- Double-glazing is the process in which a window is made from two panes of glass with an air space between them. The space between the glasses is typically several millimetres thick. The air trapped between the panes of glass forms a layer of insulation and makes a building more energy efficient by reducing heat transfer through the windows.
    - **Did you know?** Approximately 60% of heat loss in homes occurs through standard, single pane windows. Double glazed windows can reduce your heat costs by 12%.

Dual Flush Toilets

- Dual flush toilets have two different buttons that flush different amounts of water down the drain for the two types of excretion. These toilets can save a person, on average, 20 litres of water a day. That's 7,300 litres of water a year!
    - **Did you know?** If 51 people used a dual flush toilet every day for a year, all the water that is saved can fill a swimming pool.

Fluorescent Lights

- Incandescent bulbs require energy to heat a piece of filament so it glows white, producing light. Fluorescent bulbs use gas to produce light through chemical reactions therefore generating less heat and requiring less energy.

- **Did you know?** Fluorescent light bulbs use about 75% less energy than standard bulbs. They last up to 10 times longer and can save you at least $100 per bulb.

Insulation:

- Insulation keeps heat in buildings during cold winters and out during hot summers. It is put into the walls of a building to act like a shell, reducing energy consumption for heating and cooling. Numerous insulating materials can be made from environmentally friendly materials such as recycled denim and newspapers.
    - Did you know? In just one year the glass wool insulation installed in an average home saves the fuel equivalent to 8760 litres of petrol – enough to drive a typical car around the world twice!

Orientation and Structure of Classroom

- In this classroom the windows on the north side are bigger than those on the south. They are designed in this way to provide the most natural lighting to the classroom because the sun shines through the north windows for more hours in a day. These windows also save electricity because there are fewer lights necessary to light up the room.
    - **Did you know?** Natural sunlight soothes your nerves so your brain makes more endorphins, which are hormones that make you feel happy.

Plants

- Putting green plants in a building act as a natural filter by reducing the amount of volatile organic compounds (VOCs) in the air. VOCs are chemicals emitted into the air by cleaning agents, paints, adhesives, furniture, cosmetics, and aerosols. Filtering these toxins out of the air with plants allows you to focus better and stay healthy.
    - **Did you know?** Putting plants in a building can reduce headaches, throat irritation, sinus congestion, and dizziness.

Solar Panels

- Solar panels harvest the sun's energy in an environmentally friendly way. There are two types of solar panels, photovoltaic and thermal. Photovoltaic solar panels (PV) convert sunlight directly into electricity by using energy to break the bonds between electrons and their atoms. A photovoltaic thermal panel (PVT) generates electricity like PV panels and it also collects the sunrays to heat water in buildings.
    - **Did you know?** More energy from the sun strikes the earth in one hour than all the energy used by humans in an entire year.

Water Tanks

- Water tanks are installed to collect and store rainwater for later use, reduce main water use for economic or environmental reasons, and aid self-sufficiency. Stored water may be used for watering gardens, agriculture, flushing toilets, washing machines, and washing cars.
    - **Did you know?** Australia is the third largest consumer of water in the world. Collecting rainwater can decrease your home's water consumption by 40%.

Window Blinds

- Window blinds are adjustable curtains that are placed over windows to offset the heating and cooling of a room while still letting sunlight in. The metallic side of the blind acts as a reflector so the heat rays reflect off and do not heat the room.
    - **Did you know?** 50% of unwanted heat gain is from windows. Unprotected windows can cost $500 extra a year to heat and cool a home.

Appendix R: Assessment Surveys

Pre-Survey

This survey is being conducted in collaboration with Banksia Gardens Community Centre and is being used to evaluate the displays created for the centre to showcase the new sustainable classroom. Please answer each question based on your knowledge. There are no wrong answers and you are not required to answer all of them. All information will remain confidential.

1. How old are you?
    a. Under 13
    b. 14-19
    c. 20-30
    d. 31-50
    e. 51-65
    f. Over 65

2. In which activities do you participate in at Banksia Gardens Community Centre? (i.e. study group, intro. to environmental sustainability class, volunteer, tutor)
    _____
    _____

3. What is environmental sustainability?
    _____
    _____

4. What topics does environmental sustainability include? Tick all that apply.
    a. Water
    b. Energy
    c. Pollution
    d. Climate change
    e. Do not know

5. Do you save water at home? If yes how and why?
    a. Yes
    b. No
    c. Don't know
    _____
    _____

6. Do you save energy at home? If yes how and why?
    a. Yes
    b. No
    c. Don't know
    _____
    _____

7. Do you recycle at home? If yes what and why?
    a. Yes
    b. No
    c. I don't know

_____
_____

8. Do you compost at home? If yes what do you use your compost for and why?
    a. Yes
    b. No
    c. I don't know

_____
_____

9. Do you know any types of sustainable materials and/or features that are put in houses? If yes what?
    a. Yes
    b. No

_____
_____

10. Banksia Gardens Community Centre is building a new sustainable classroom. What do you know about this classroom?

_____
_____

Post-Survey

This survey is being conducted in collaboration with Banksia Gardens Community Centre and is being used to evaluate the displays created for the centre to showcase the new sustainable classroom. Please answer each question based on your knowledge. There are no wrong answers and you are not required to answer all the questions. All information will remain confidential.

1. What is environmental sustainability?

   _____
   _____

2. What topics does environmental sustainability include? Tick all that apply.
   a. Water
   b. Energy
   c. Pollution
   d. Climate change
   e. Do not know

3. Did you find the displays interesting? Which was your favourite display? Why?
   a. Yes
   b. No

   _____
   _____

4. What did you learn from our displays?
   a. Water

   _____
   _____

   b. Energy

   _____
   _____

   c. Pollution

   _____
   _____

   d. Climate change

   _____
   _____

   e. Recycling

   _____
   _____

   f. Composting

   _____
   _____

5. What did you learn about the sustainable features of the new classroom? Are there any features that particularly interested you?

_____
_____

6. After learning about environmental sustainability do you think you will apply some sustainable practises to your everyday routine? If so, what?
    a. Yes
    b. No

_____
_____

7. Is there anything you would have liked to see in our displays that we did not include? If yes what?
    a. Yes
    b. No

_____
_____

8. Do you have any other suggestions for improvement to our displays?

_____
_____

Thank you for your time! Your feedback is much appreciated.

Figure 91: Mock tour